CALIFORNIA
ENERGY
COMMISSION

Public Interest Energy Research Program
Energy Systems Integration Team

Electricity Transmission Research and Development Assessment and Gap Analysis

DRAFT CONSULTANT REPORT

February 2003
P500-03-011D

Gray Davis, *Governor*

CALIFORNIA ENERGY COMMISSION

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Electricity Transmission R&D Assessment & Gap Analysis

Interim Report

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Submitted to:

California Energy Commission
PIER Program

February 17, 2003

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Preface

This report presents Navigant Consulting's interim findings and observations related to Transmission for the Energy Systems Integration Area of the California Energy Commission Public Interest Energy Research (PIER) Strategic Program. Comments or questions on any aspect of this report including both the high level observations and the project details should be addressed to:

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Executive Summary

The Energy Systems Integration area of the California Energy Commission's Public Interest Energy Research (PIER) Program is developing its 5-year research plan for public interest in the transmission space. As part of this R&D Assessment, four Focus Areas were identified in which research initiatives could be categorized (Figure ES-1).

Figure ES-1: Focus Area Summary

Focus Area	Component Optimization	Capacity Additions	Advanced System Operations	Markets
Sub-Areas	• Ratings • Equipment Reliability & Availability • System Reliability & Security • System Restoration • Equipment Efficiency	• System Upgrades • System Configuration • New Components	• System Operability • Operating Information	• Market Design • Market Operations • Business Models
Research Initiatives	19	7	8	12

To begin the R&D assessment, a preliminary literature search of multiple sources was conducted to determine past, present and planned research in the private and public sectors. Significant additional input was obtained through an interview process with representatives of industry, non-profit and government efforts in transmission R&D. In all, over 185 projects were examined as part of this assessment. Detailed project information may be found in the Appendix.

Research initiatives were mapped against the state of the technology development and the impact/timing of achieving each initiative. The four states of technology development are research, development, demonstration and commercialization. The Impact-Timing framework includes four levels (Figure ES-2).

Figure ES-2: Impact-Timing Framework

Level	Description

Base	Although essential to today's business these technologies represent the common denominator in performance and cost
Key	These technologies are important for performance and cost advantages for today's industry players
Pacing	Although they are not fully embodied in current products, they may, if successfully applied, have a substantial impact on the performance and cost profile in the reasonably near future
Emerging	These technologies may have a large impact on the performance and cost profile in the future but this is far from certain

Note: There is a normal progression from the Emerging technology level to the Base technology level as technologies become developed and more widely applied.

Additionally, the degree to which the research initiatives have been pursued was captured such that each of the initiatives is identified as either having significant, moderate or little/no gap. A more significant gap implies greater need for investment or activity.

From the analysis completed thus far, the following preliminary observations were drawn:

- There are gaps in transmission R&D
- Transmission is a mature technology as evidenced by the level of the activity in the Key/Base area, and industry players appear to focus on improving cost performance and service reliability through incremental improvements
- Transmission technologies and the associated R&D in this area are expensive, resulting in a predominance of consortium projects

These interim findings and preliminary observations be discussed by the participants in the March 12, 2003 CEC Workshop. The key inputs and perspectives developed in that workshop will be used to refine these interim findings and preliminary observations and create a final report.

Chapter 1: Introduction

The electric power industry has been undergoing fundamental changes as a direct result of state and federal regulation. The unbundling of vertically integrated electric utilities has presented a variety of opportunities and challenges. The transmission sector is facing particularly significant challenges as it is forced to cope with wholesale and retail energy markets, re-regulation, and the need to keep up with infrastructure investments amidst uncertainty in business models. These challenges are creating a gap between future demand for transmission capacity, and the amount of capacity being built. At the same time, developments in electric power transmission technology and the marketplace may hold the keys to solving some of the problems facing the transmission system. All of this requires a fresh analysis of the transmission landscape to identify key challenges appropriate for public interest research. The Energy Systems Integration (ESI) area of the CEC's PIER program is developing its 5-year research plan organized within the following Focus Areas:

- Component Optimization
- Capacity Additions
- Advanced System Operations
- Markets

A major step in the research plan development process is to understand current research being conducted by industry, nonprofit organizations and government; and to identify where gaps exist. Information collected through research, interviews, and a public workshop will help identify appropriate potential PIER program activities. This information, along with application of scenario planning, public interest criteria, and the needs of the California transmission system, will support ESI in developing a plan and solicitations to address those activities.

Background Research and Interviews

The research effort began by identifying key stakeholders in the transmission sector that are known to be heavily involved in numerous areas and projects. These "hub" organizations were chosen from various sectors including equipment manufacturing, government, academia, transmission operators (ISOs) and utilities. Some hub organizations chosen are collaborative bodies that are involved in transmission, as well as other electric power areas. The selected hub organizations were interviewed, and asked to provide information regarding projects, funding, and collaborative relationships with other organizations. This information served as a preliminary roadmap to identifying major topics of research as well as potential interview candidates from other organizations, and sources of additional information on transmission R&D activities.

Significant input was obtained through the interview process with representatives of the hub organizations and others with activities in transmission. Conversations and completed questionnaires captured concerns, additional information and insight into the nature of R&D efforts. This, along with the information gathered in a literature search, was used to

formulate the key issues and research initiatives that exist in the areas of Component Optimization, Capacity Additions, Advanced System Operations and Markets.

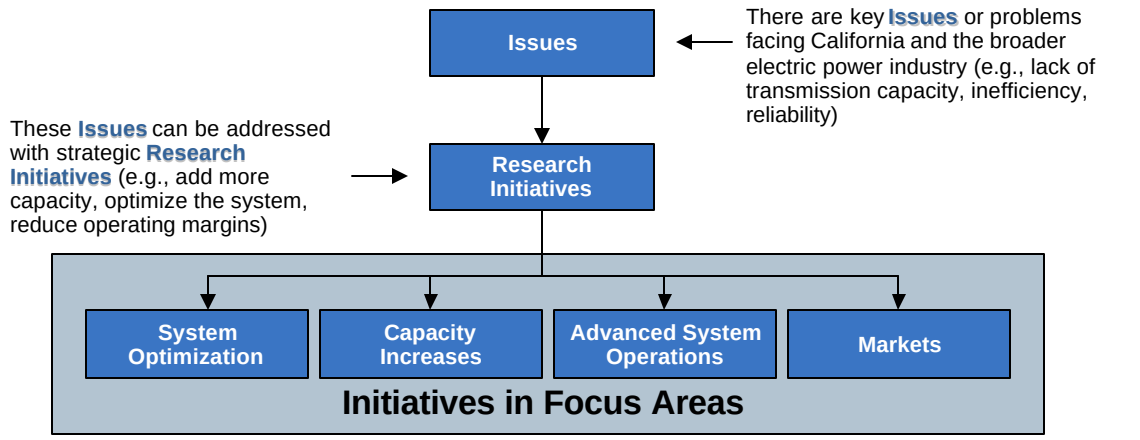
The organizations found to be active in transmission R&D along with details of their projects and activities can be found in the Appendix. It is important to note that there is additional proprietary R&D taking place for which companies are unable to share significant information.

Framework of Analysis

In parallel with, and incorporating the information gathered from the background research and interviews, a framework was created for assessing the status of the transmission R&D efforts (Figure 1-1).

There are key issues or challenges facing California and the broader electric power industry (e.g., lack of transmission capacity, inefficiency, reliability). These issues can be addressed with strategic research initiatives (e.g., build more cheap capacity, optimize the system, reduce operating margins). Research and development currently underway or planned is working to solve very specific problems. The assessment groups the initiatives into Focus Areas that more clearly support the research initiatives and issues. Chapter 2 delves deeper into the details surrounding the process by which the issues were identified and elaborates on the research initiatives that address those issues.

Figure 1-1: Taxonomy of Analysis Framework



An overview of representative research projects most applicable to the research objectives of the CEC ESI area is presented in Chapter 3. Equipped with the issues, research initiatives, and project information, the level and concentration of activities are mapped out and potential areas where funding might be warranted are thus discussed in Chapter 4. Inclusion of the elements stated thus far opens the way for a more effective discussion among the various stakeholders of transmission. Preliminary observations are detailed in Chapter 5.

These interim findings and preliminary observations be discussed by the participants at the March 12, 2003 CEC Workshop. The key inputs and perspectives developed in that workshop will be used to refine these interim findings and preliminary observations and create a final report.

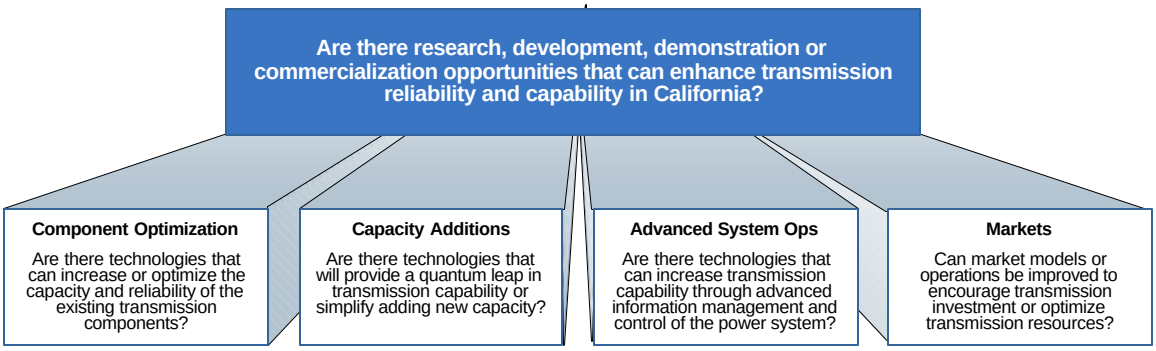
Chapter 2: Issues and Research Initiatives

The results of the literature search and the interviews provided essential inputs to isolate issues facing electric power transmission and the research initiatives to address these issues. In the interviews, representatives of industry, non-profit organizations and government provided information on their visions for transmission, where key obstacles exist, where their transmission efforts are focused, and the expected outcome for such efforts.

Issues

The information that had been collected was pooled and examined for key insights. Obstacles to more effective development and management of transmission resources discovered during the information collection process were identified and organized. The issues are identified in the form of critical questions and arranged along the lines of the four Focus Areas: Component Optimization, Capacity Additions, Advanced System Operations, and Markets (Figure 2-1).

Figure 2-1: Transmission Issues Analysis



Note: For the purposes of this work, "technologies" include hardware, software, and innovative tools or applications

Research Initiatives

Current and proposed efforts to address the issues were identified during the interview process and formed the basis of the research initiatives identified. The research initiatives address the issues in the four Focus Areas of Component Optimization, Capacity Additions, Advanced System Operations, and Markets.

Component Optimization

In the Component Optimization focus area, we identified 19 research initiatives within five sub-areas that could produce technologies to release extra transmission capacity from the existing transmission system through optimization (Figure 2-2).

Figure 2-2: Issues and Research Initiatives – Component Optimization

Component Optimization	
Issues	**Research Initiatives**
• Can the ratings of existing equipment/components be increased? • Can we reduce the operating reserve margins of the system? • Can the system be modified to meet changing conditions?	**Ratings & Operating Limits** • Use actual system conditions in place of worst case conditions to increase thermal and stability limits • Improve the cooling capability of equipment • Develop new operating techniques
• Can technology be applied to increase the reliability and/or availability of equipment?	**Equipment Reliability & Availability** • Adopt advanced materials that enhance the durability of system components • Employ advanced design techniques that enhance the durability of system components • Reduce outages due to equipment failure (e.g., preventive/predictive maintenance)
• Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	**System Reliability & Security** • Increase the precision of system protection/operation • Reduce the impact of environmental conditions (e.g., lightning, fire, storm, salt) and terrorism • Design systems/system components to withstand seismic events • Design systems/system components to improve performance of transmission facilities experiencing geomagnetically induced currents
• Can we decrease the time required to restore failed components?	**System Restoration** • Develop self-healing networks • Improve fault location identification to decrease restoration time • Optimize/prioritize system restoration against various criteria • Novel equipment/configuration design to manage failures and rapid system restoration • Mechanized/automated repair
• Can we increase the efficiency of system components?	**Equipment Efficiency** • Develop materials to increase efficiency of system components (e.g., HTS, ceramics, carbon fiber) • Reduce the cost of transmission related technologies and components • Develop designs/configurations to increase efficiency of system components • Apply storage technologies to enhance transmission capabilities

Examples of projects related to Component Optimization include the following:

- **Real-Time Ratings for Path 15 (CEC, Valley Group, Niskayuna Power Consultants, Power Delivery Consultants, PG&E and CA ISO):** This project examines the feasibility of providing real-time transmission line ratings by monitoring the conductor tension and environmental factors for a multiple transmission line path and communicating the real-time data to PG&E and the ISO. This project also provides a calculated real-time rating for the path directly to the system operators.

- **CEIDS Self Healing Grid (EPRI):** The Consortium for Electric Infrastructure to support a Digital Society (CEIDS) is a public-private initiative that is working to advance Wide Area Measurement System (WAMS), develop a high-voltage fault anticipator, develop ultra-fast pattern recognition to categorize and identify threats, create intelligent islanding schemes that will separate the system into self-sustaining parts, develop auto-recovery systems to reconnecting the grid, develop secure control and communications protocols, and develop methods and technologies for distributed control and self-regulation

- **Energy Storage to Mitigate Stability Limited Transmission System (EPRI):** This project will determine preferred design(s) and cost estimate(s) for energy storage systems to provide the real power transient damping necessary to increase stability limits of the transmission systems. The storage system may be deployed independently or added to FACTS devices to increase the transmission

stability limit. Special attention will be paid to storage systems that can be easily maintained.

- **Impact of Protection Systems on Reliability (PSERC):** This project is developing tools for computing the increase in transmission system reliability from investments in new equipment, and from changes in relaying philosophy or in operating policy. A statistical approach is used to investigate where changes in the protection system could be most effective and to evaluate the reliability improvement obtained from monitoring the protection system.

- **Optical Voltage & Current Sensors Demonstration (BC Hydro and NxtPhase):** This project verified the performance of NxtPhase Corporation's optical sensors in a substation environment. The sensors provide high accuracy measurements of voltage and current at lower cost compared to conventional equipment, and can be used for metering, equipment protection and power quality management.

Specific comments regarding issues and research related to Component Optimization received during the interview process are provided below.

> "[Transmission] congestion is an economic element that consumers pay for."
>
> -- *Research Consortium*

> "Technology transfer is a gap that's hard for the government to bridge."
>
> -- *Federal Agency*

> "Voltage Stability or instability is a key issue. 9 out of last 10 outages due to voltage instability. Los Angeles is a disaster waiting to happen".
>
> -- *Large Regional Utility*

> "There is a shift to more motors and other complex impedance loads that is beginning to create voltage stability problems in the system."
>
> -- *Equipment Manufacturer*

> "The biggest issues in electricity transmission are power delivery capacity and system reliability. Much of the power transmission and distribution assets in the state of California are past their service life and are in a dire need of upgrade or replacement."
>
> -- *Large Regional Utility*

Capacity Additions

In the Capacity Additions focus area, we identified 7 research initiatives within three sub-areas that could lead to major increases in transmission system capability (Figure 2-3).

Figure 2-3: Issues and Research Initiatives – Capacity Additions

Capacity Additions	
Issues	**Research Initiatives**
• Can we upgrade system elements to increase their capacity (e.g., voltage, conductor)?	**System Upgrades** • Increase operating voltage • Increase the capacity of the conductor • Increase transfer capability/limits
• Are there novel component configurations to increase capacity (e.g., AC to DC conversion, phase orientation, corridor design, underground)? • Can we site, permit and construct new facilities in a timely fashion? • What are the technical/market limitations or tradeoffs between generation and transmission? • Do we understand the complex set of values/benefits that transmission provides the power system?	**System Configuration** • Increase/simplify the application of DC transmission • Develop novel phase configurations to increase capacity • Develop novel configurations to reduce environmental/public impact (e.g., aesthetics, EMF, wetlands, wildlife)
• Do new transmission components offer significant increases in capacity?	**New Components** • Increase the capacity of transmission components (e.g., conductors, transformers, towers, insulators, underground cable, etc.)

Examples of projects related to Capacity Additions include the following:

- **Rights-of-Way Environmental Issues in Siting, Development and Management (EPRI, CEC and various contractors):** This program develops and delivers scientific information and innovative approaches to help rights-of-way (ROW) owners/users contain costs while responding to the competitive marketplace and practicing environmental stewardship.

- **Design And Cost Estimates For Novel, Low-Cost Overhead Transmission Lines (EPRI):** This project aims to lower transmission capital costs and construction time by using the latest best practices for design, low cost materials, procurement, and quick construction. This project will develop a Handbook delineating best practices for such transmission line capital improvements.

- **High Surge Impedance Loading (SIL) Transmission Corridors (EPRI and CA ISO):** Surge Impedance Loading (SIL) of a transmission corridor is an index used to measure the power carrying capability of a transmission line, particularly for long transmission lines. SIL is a function of the transmission voltage and the surge inductive and reactive impedance of the transmission line. The project will investigate methods to increase SIL for existing lines as well as for new line designs.

- **Superconductivity for Electric Systems (DOE, 27 manufacturers, 8 labs, 10 utilities, and 19 universities):** The DOE Superconductivity for Electric Systems program is the leading US federal effort in High Temperature Superconductors (HTS) research involving world-class industry/ government/ university teams focused on developing and commercializing electric power applications of HTS.

Specific comments regarding Capacity Additions issues and research initiatives received during the interview process are provided below.

> "Transmission capacity is not keeping up with increases in load or generation. The industry structure does not facilitate investment. Communal transmission planning and investment at not coordinated with private investment in generation. There are basic conflicts."
>
> -- *National Lab*

> "The biggest issues are lack of sufficient transmission capacity, justifying new transmission additions, and the issue of who is going to pay for these new additions."
>
> -- *Transmission Operator*

> "Across the U.S., the number of miles of new transmission lines being constructed has not kept pace with the addition of new generation."
>
> -- *National Lab*

Advanced System Operations

In the Advanced System Operations focus area, we identified 8 research initiatives within two sub-areas that could increase transmission capability through operating improvements (Figure 2-4).

Figure 2-4: Issues and Research Initiatives – Advanced System Operations

Advanced System Operations	
Issues	**Research Initiatives**
• How can we improve the integration of power system components? • What are the practical limitations of transmission system size and scope? • What are the anticipated values/benefits of improved system operations?	**System Operability** • Develop substation automation • Develop enhanced communications architecture • Integrate and streamline database and information systems • Develop expert systems to carry out complex control orders
• How can we improve the quality and quantity of operating information?	**Operating Information** • Develop operating condition monitoring (e.g., power flow, voltage, temperature) • Develop presentation and communication tools for operators (e.g., outage mapping, congestion profiling) • Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling) • Develop tools for obtaining and presenting system information for planning purposes

Examples of projects related to Advanced System Operations include the following:

- **USAT MOD-2 Satellite Communication System (CEC, Edison Technology Solutions):** The purpose of this project was to promote development of the USAT satellite communications system to deliver high-reliability communications for utility supervisory control and data acquisition (SCADA) systems under all types of weather conditions.

- **Power Quality-Based Transmission Asset Optimization Tool (EPRI):** The project will develop a methodology for a power quality transmission asset optimization tool that will allow energy companies to prioritize investment in T&D assets and to determine the cost optimized solution between utility side investment and customer side improvement. The specific power quality determinants that will be used in the value based reliability model are voltage sag and the associated economic impact of voltage sags on sensitive customers.

- **Visualization of Power Systems (PSERC, TVA, Entergy, Wisconsin Electric, ComEd, and WAPA):** This project's goal is to develop innovative methods to assist players in the electricity industry to extract and visualize knowledge concerning power system capacity and constraints. Researchers will explore the use of techniques for knowledge extraction using two-dimensional displays and a three-dimensional virtual environment.

- **Real-Time Reliability Management Tools (CERTS, NERC, California ISO, and Electric Power Group):** Key activities include development and demonstrations of prototypes for: 1) new near-real-time reliability adequacy tools for operators, 2) real-time monitoring, performance tracking for system area control error, and area interchange errors for security coordination, and 3) wide-area information visualization systems for monitoring the grid accurately, identifying root causes of problems, and taking swift action to remedy abnormal situations.

- **Short-Term Regional Generation Forecasting Tool (CA ISO and EPRI):** This project is to build a short-term regional generation forecasting tool for Supplemental Energy/Real Time Dispatch purposes. The main idea is to base forecasts on the existing weather related information that is being used for load forecasting purposes. Working on this tool with EPRI will provide tools for the CA ISO's dispatchers and the ramp planners.

Specific comments regarding Advanced System Operations issues and research initiatives received during the interview process are provided below.

"In the future we want to move toward an automatic switchable network."
-- *Research Consortium*

"Real-time control will be well along within 5 years."
-- *Federal Agency*

"In operations, there are serious congestion issues that increase the cost for customers.

In planning, the utility planners no longer have a link to all the information needed to effectively identify where to put the necessary assets. Deregulation put a lot of limitations on utility planners."
-- *Equipment Manufacturer*

"Technology/engineering issues include the following:
- How to advance real-time monitoring and control technologies to allow power system operators to better quantify reliability risks and take actions to mitigate those risks.
- How to consider market behavior in operational risk assessment practices.
- How to advance automation and sensor technologies to improve maintenance and equipment replacement practices, and to improve status monitoring of the power system."
-- *Research Consortium*

"Metering could be significantly improved; sophisticated approaches to system metering could facilitate better market models."
-- *Transmission Consultant*

"We spend a lot of time talking to the operators and ISO folks. If the operators aren't using [the technology], we're wasting our time."

-- *Research Consortium*

Markets

In the Markets focus area, we identified 12 research initiatives within three sub-areas that could address the efficient use of existing transmission resources, and ensure that the appropriate market signals are present to encourage investments in new transmission resources (Figure 2-5).

Figure 2-5: Issues and Research Initiatives – Markets

Markets	
Issues	**Research Initiatives**
• Are current market designs inhibiting the development of new transmission facilities?	**Market Design** • Develop mechanisms to value and assign capacity rights • Determine appropriate ancillary services • Develop effective hedging instruments • Develop modeling tools to test and simulate markets
• What information and tools are needed to improve market performance? • What is the optimum balance between system operations (ISOs), asset management (owners), and markets (buyers and sellers)?	**Market Operations** • Identify ISO and Transmission Ownership requirements • Provide information and analysis to support bidding strategies • Develop systems to ensure transaction compliance • Develop rules and systems for congestion management
• Is the level of risk or the perception of risk preventing the development of new transmission facilities? • Can the transmission system provide a broader range of products or services? • What is the tradeoff between market standards and product innovation and value? • Are current transmission business models compatible with future markets and regulation?	**Business Models** • Determine how to encourage sustainable investment in transmission • Determine the best way to regulate transmission • Determine optimal ownership of transmission • Develop transmission value network (the elements and relationships that create value for customers in transmission)

Examples of projects related to Markets include the following:

- **California Wind Energy Consortium (CEC and UC Davis):** The purpose of this project is to provide the initial impetus for establishing the forum or consortium of parties and the recognition that is needed at the state level. Investigative white papers will be prepared that offer plausible approaches to optimizing wind plant facilities including transmission infrastructure issues.

- **Power Market Simulator for Wholesale Energy Markets (EPRI):** The Power Market Simulation Software, now under development, will be used to simulate hedging strategies in electricity markets before they are put into practice. It will account for market contingencies in market operations and production.

- **Costing and Pricing of Ancillary Services (PSERC, TVA, ConEd, and WAPA):** This project investigated methods for establishing justifiable costs for ancillary services. The work focused on the issues of costing reactive power and voltage control. It addressed questions of what it costs to maintain voltage; what

it costs an energy provider to use an exciter; what operating costs can be allocated to voltage control; and how these services might affect a third party.

- **Design and Development of Bidding Agents for Electric Supply Auctions (PSERC):** The goal of this project is to develop and demonstrate software agents for electric supply auctions, such that commercial performance is increased without compromising reliability. This work will develop bidding agents, an organization for these agents (particularly, the rules they must obey), and demonstrate these agents and their organization in simulated power systems.

- **Develop Transmission Pricing Methods Sensitive to Reliability (BC Hydro):** This project is designed to develop transmission pricing methods which are sensitive to reliability and provide price differentiation for different customers with different levels of reliability, price signals to improve overall system reliability, and incentives to properly locate future generation and load.

Specific comments regarding market issues and research initiatives received during the interview process are provided below.

> "Regulators are not putting the incentives needed for transmission to be profitable; the financial markets are not willing to put money into transmission; right-of-way for new transmission is next to impossible to obtain."
>
> -- *Equipment Manufacturer*

> "If both entities (owners and operators) operated under a similar set of regulations, the situation would be tolerable."
>
> -- *Research Consortium*

> "Some of the biggest issues involve the new players and the new rules that are creating many more transactions on the grid. New players goals are not necessarily the same as the transmission operator / owner. We need to have some semblance of reasonable behavior from the new players to ensure the grid remains reliable. (e.g., requirements for transmission reinforcements / RAS. Also, policies to deal with interconnection queue position when generation stops development work.)"
>
> -- *Large Regional Utility*

> "We need incentives in place to encourage investment in transmission. Any incentives need to work with [Standard Market Design]."
>
> -- *Federal Agency*

> "Policy issues include the following:
>
> - How to plan and prioritize transmission infrastructure investments and then get the investment plans implemented.
> - How to plan and implement congestion management practices in the interim period before transmission investment plans are completed.
> - How to get siting issues resolved to make transmission investment plans viable.

- How to direct or incentivize generation location decisions to relieve transmission bottlenecks.
- How to integrate the testing and validating of proposed market designs into decision-making processes."

-- *Research Consortium*

Chapter 3: Transmission R&D Landscape

This chapter presents an overview of the projects that were identified during the information-gathering portion of the R&D assessment. It also describes the parties who are performing and sponsoring the research, and the general nature of R&D in the transmission space. A technology assessment framework is also presented that was used to analyze R&D activities according to development and competition. A complete listing and a description of the projects are presented in the Appendix.

Industry and Stakeholder Overview

The transmission sector holds a unique position within the electric power industry in that it touches each of the other sectors: generation, power marketing, distribution, and retail delivery. There are key stakeholders with interests in transmission that continue to shape the nature of the physical system, as well as the transmission business.

Owners – Today, this sector generally comprises electric utilities, or divisions of formerly integrated electric utilities; owners also include power authorities and specially designed transmission companies. Owners are responsible for the maintenance and capitalization of the transmission system, and generate revenue through open access transmission tariffs. Concerns for owners include a strong rate base, cost efficiency and maintaining a reliable system.

Operators – Increasingly, operation of the transmission system is being done by large, centralized organizations know as Independent System Operators (ISOs). While many systems are still operated by large utility operators, the regulatory trend is moving toward increased activity by ISOs or Regional Transmission Organizations (RTOs). The primary concern for operators is system reliability ("keeping the lights on"). Some ISOs also administer energy markets, and therefore are concerned with the smooth, efficient operation of these markets as well.

Customers – With the creation of open access, the use of the transmission system is no longer limited to its utility owners and operators. Now, buyers and sellers of bulk power contract directly with owners for transmission service to deliver their commodity. Customers are interested in having sufficient transmission capacity where they need it, when they need it, to support their energy transactions; they are also interested in holding down costs of transmission service.

Regulators – In most areas of the U.S., the majority of the transmission system is under the regulatory jurisdiction of the Federal Energy Regulatory Commission, but state utility commissions typically retain jurisdiction over issues of environment and land (real estate and siting). Regulators are a balance to the natural monopolies that exist in transmission, and generally focus on the commercial side of transmission, including pricing and service requirements. They are also playing a central role in altering the business models of the entire electric power industry, including transmission.

Manufacturers – This sector includes the companies that produce power equipment, as well as those who design and integrate the systems and devices used to monitor and control the power system. This sector has traditionally served the Owners and Operators, as well the Customers involved with generation.

R&D Activity Overview

The transmission industry has a unique set of characteristics with respect to R&D. Relative lack of competition, a history of risk aversion and conservatism, industry maturity, and other factors have created a situation where a significant portion of the research is carried out by collaborative research organizations that are funded by multiple public or private sources, thereby sharing the risks and the potential rewards. Noteworthy examples of these are the Electric Power Research Institute (EPRI), the Consortium for Electric Reliability Technology Solutions (CERTS), and the Power Systems Engineering Research Center (PSERC). Other parties including electric utilities, equipment manufacturers and national laboratories are also involved in transmission R&D. Their efforts are often coordinated with or through collaborative organizations such as the above. Funding for the collaborative R&D organizations comes from industry and the public sector, with the Department of Energy, utilities, and the California Energy Commission providing significant resources. Equipment manufacturers also contribute as part of commercial development and demonstration projects.

Based on sheer numbers of projects, EPRI, CERTS, and PSERC are most active players in the transmission R&D space. What is not clear from the research or published information is how much R&D is taking place behind closed doors in industry that could have a significant impact on transmission technology. While our information gathering revealed relatively few projects being conducted individually by players from the manufacturer and utility sectors, we suspect that significant resources may be going to R&D related to transmission, particularly at the development and demonstration end of the spectrum. Companies (rightfully) will not divulge information regarding R&D that may provide them proprietary advantage for fear of compromising that R&D. It is also clear that some relatively young companies commercializing new technologies are drawing their funding from private sources and corporate partnerships (e.g., American Superconductor, NxtPhase).

Companies developing or commercializing new technologies also represent a significant area of investment. However, it is not clear how much of these companies budgets can be classified as R&D. Companies such as American Superconductor and NxtPhase are offering technologies that fit directly with research initiatives described in this report.

Activity Within Focus Areas

In conversations with numerous individuals from various industry sectors, many stated their belief that significant amounts of excess capacity exists in the transmission system, but it cannot be tapped due to the nature of energy markets and limitations of operating capability. R&D activity generally supports this belief, with a majority of projects identified being classified as Component Optimization or Advanced System Operations. Figures 3-1 presents the number of projects in each Focus Area/Sub-Area.

Figure 3-1: R&D Activity Summary

Focus Area/Sub-Area	Number of Projects
Component Optimization	**115**
Ratings and Operating Limits	14
Equipment Reliability & Availability	36
System Reliability & Security	32
System Restoration	7
Equipment Efficiency	26
Capacity Additions	**22**
System Upgrades	10
System Configuration	7
New Components	5
Advanced System Operations	**90**
System Operability	34
Operating Information	56
Markets	**23**
Market Design	17
Market Operations	3
Business Models	3

Note: Some of the 185 projects identified fall in more than one Focus Area/Sub-Area

Framework for Analyzing Activity

To determine the focus of current research, we determined the issues and research initiatives being addressed by each project or project category. To gain further insight into the nature of this research and technology development, the projects were also analyzed by their stage of technology development and their competitive impact.

Technology generally follows a natural progression along the technology development chain; which consists of 4 stages: research, development, demonstration, and commercialization (Figure 3-2).

Figure 3-2: Technology Development Process

Research	Development	Demonstration			Commercialization	
		Initial System Prototypes	Refined Prototypes	Commercial Prototypes	Market Entry	Market Penetration
• General assessment of market needs • Assess general magnitude of economics • Concept and Bench testing • Basic research and sciences (e.g., materials science)	• Research on component technologies • Development and initial of product offering • Pilot testing	• Integrate component technologies • Initial system prototype for debugging • Demonstrate basic functionality	• Ongoing development to reduce costs or for other needed improvements • "Technology" (systems) demonstrations • Some small-scale "commercial" demonstrations	• "Commercial" demonstration • Full size system in "commercial" operating environment • Communicate program results to early adopters/ selected niches	• Initial commercial orders • Early movers or niche segments • Product reputation is initially established • Business concept implemented • Market support usually needed to address high cost production	• Follow-up orders based on need and product reputation • Broad(er) market penetration • Infrastructure developed • Full-scale manufacturing

The impact-timing framework describes how important a technology is to performance and cost among industry players. Impact-timing is extrinsic with respect to the technology, and closely related to the industry in which the technology is applied. The framework comprises four levels (Figure 3-3).

Figure 3-3: Impact-Timing Framework

Level	Description
Base	Although essential to today's business these technologies represent the common denominator in performance and cost
Key	These technologies are important for performance and cost advantages for today's industry players
Pacing	Although they are not fully embodied in current products, they may, if successfully applied, have a substantial impact on the performance and cost profile in the reasonably near future
Emerging	These technologies may have a large impact on the performance and cost profile in the future but this is far from certain

Note: There is a normal progression from the Emerging technology level to the Base technology level as technologies become developed and more widely applied.

Examining the intrinsic (technology development stage) and extrinsic (impact-timing) characteristics of a technology provides a useful framework for determining which technologies should be pursued, the appropriate level of investment and the timing for that investment. Technical risk varies along the technology development chain; the highest risk associated with research. Market or adoption risk varies along the level of impact-timing; the highest risk is with emerging technologies. Rewards do not vary according to where the technology is on the technology development chain; however, emerging technologies generally offer greater rewards than base technologies. Therefore, research activities in emerging technologies tend to have the greatest technical/market risk and the greatest reward. Commercial, base technologies have the lowest market/technical risk and the lowest reward. For emerging commercial technologies, there is little technical risk, but high market risk and high rewards.

Chapter 4: Gaps in R&D Activity

Approach

In this chapter, gaps are identified for each of the research initiatives discussed in Chapter 2, based on the projects presented in Chapter 3. Gaps are defined as disparities between the current level of private/public activity and the required level of activity to ensure a strategy has a reasonable chance for success at resolving the issue it is addressing.

The research initiatives were first plotted by their position on the technology development chain (research, development, demonstration and/or commercialization) and the competitive impact of that strategy (base, key, pacing or emerging). Interviews with researchers and company representatives working on these research initiatives provided the baseline information for assessing gaps. The magnitude of the gap for each research initiative is based on the amount and thoroughness of the research pursuing a particular initiative. Figure 4-1 presents the framework that was used.

Figure 4-1: Research Gap Descriptions

Designation	Description
Significant Gap	Few companies or entities are adequately pursuing this strategy at a level that will likely ensure the strategy has a reasonable chance of success to help resolve the issue it is addressing. This could indicate an area that has been overlooked or just emerging as a viable research initiative. However, it may be an initiative that is not appropriate or feasible to pursue at this time.
Moderate Gap	Continued *and* additional activity is likely required to ensure the research has a reasonable chance of success to help resolve the issue it is addressing.
Little or No Gap	*Little* additional work beyond what is currently funded is necessary. There are many companies and/or entities pursuing this initiative. The current level of activity is likely appropriate to ensure the strategy has a reasonable chance of success to help resolve the issue it is addressing.

Gap Analysis by Focus Area

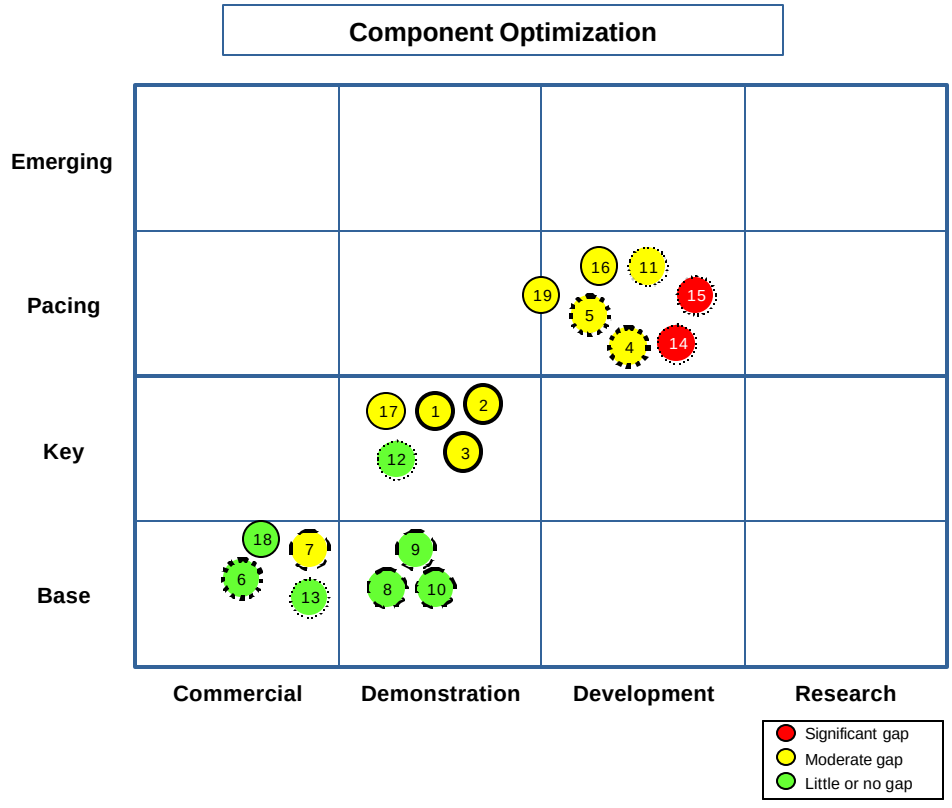
Component Optimization

Research initiatives within Component Optimization are aimed at making improvements to the fundamental components of transmission and power delivery. Common themes are a desire to squeeze extra capacity out of the existing system by increasing equipment ratings, and enhancing the reliability and performance of the system to allow reductions in operating safety margins.

- Research initiatives are generally either Base/Key – Commercial/Demo, or Pacing/Development, with the largest gaps being in the research initiatives falling in the Pacing/Development category.
- Research initiatives are seeking to apply better information and operating techniques to increase the capacity of system components such as lines, transformers and other power equipment. In many cases the technology may not be revolutionary, but lack of wide application may be limiting the industry's understanding and trust in the technologies.
- Some technologies such as high temperature superconductors, ceramics and polymers have been developed in concept, but are in need of demonstration to create awareness, develop operating experience, and ultimately reduce costs.
- Ideas that have been successfully developed in other industries such as automation and mechanization have not yet been applied in the power delivery business. Over time, such technology could enable significant cost savings and create a fundamental shift in the operating and cost structure of the industry. However, there appears to be little activity in this area.

Figure 4-2: Gap Analysis – Component Optimization

Research Initiatives – Component Optimization	
Ratings & Operating Limits	1 Use actual system conditions in place of worst case conditions to increase thermal and stability limits 2 Improve the cooling capability of equipment 3 Develop new operating techniques
Equipment Reliability & Availability	4 Adopt advanced materials that enhance the durability of system components 5 Employ advanced design techniques that enhance the durability of system components 6 Reduce outages due to equipment failure (e.g., preventive/predictive maintenance)
System Reliability & Security	7 Increase the precision of system protection 8 Reduce the impact of environmental conditions (e.g., lightning, fire, storm, salt) and terrorism 9 Design systems/system components to withstand seismic events 10 Design systems/system components to improve performance of transmission facilities experiencing geomagnetically induced currents
System Restoration	11 Develop self-healing networks 12 Improve fault location identification to decrease restoration time 13 Optimize system restoration against various criteria 14 Novel equipment/configuration design to manage failures and rapid system restoration 15 Mechanized/automated repair
Equipment Efficiency	16 Develop materials to increase efficiency of system components (e.g., HTS, ceramics, carbon fiber) 17 Reduce the cost of transmission related technologies and components 18 Develop designs/configurations to increase efficiency of system components 19 Apply storage technologies to enhance transmission capabilities



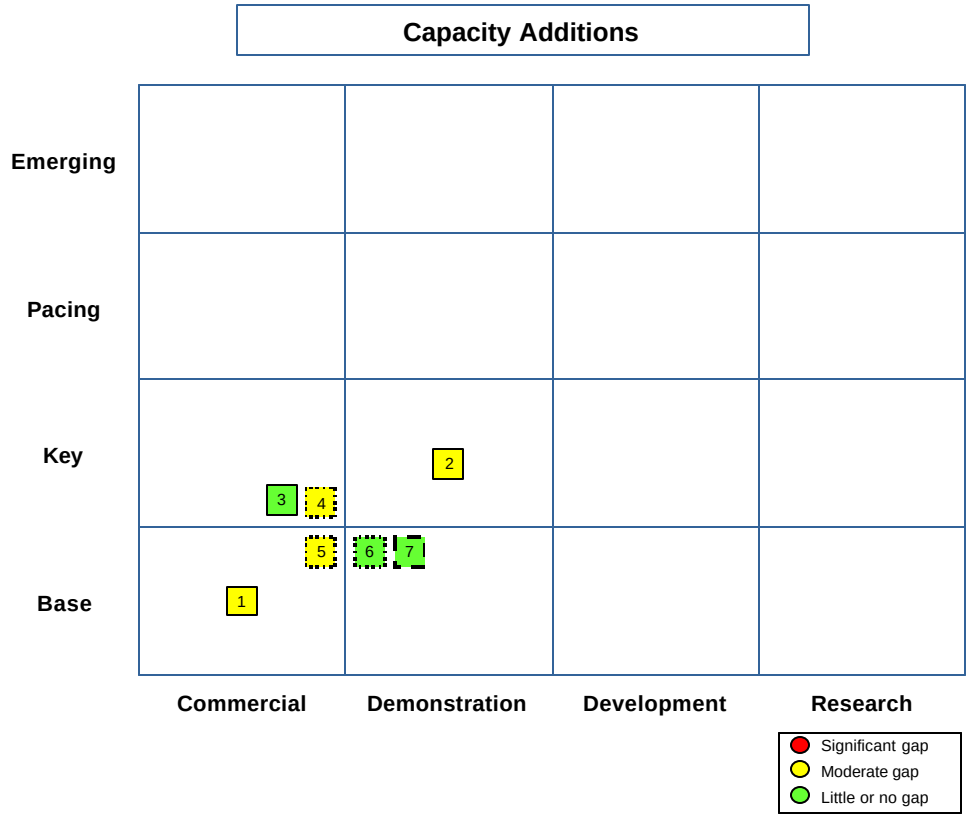
Capacity Additions

Research initiatives within Capacity Additions deal with achieving large-scale gains in transmission capacity by changing the characteristics and configuration of the transmission system. Whereas Component Optimization involve efforts to maximize the benefits derived from existing infrastructure, Capacity Additions involve more fundamental shifts in the technology and methods to meet the long-term electricity needs.

- Research initiatives are generally Base/Key – Commercial/Demo
- There are no significant gaps given existing research initiatives
- Moderate gaps appear to exist in the area of local high voltage transmission

Figure 4-3: Gap Analysis – Capacity Additions

Research Initiatives – Capacity Additions	
System Upgrades	1 Increase operating voltage 2 Increase the capacity of the conductor (bigger wire) 3 Increase transfer capability/limits
System Configuration	4 Increase/simplify the application of DC transmission 5 Develop novel phase configurations to increase capacity 6 Develop novel configurations to reduce environmental/public impact (e.g., aesthetics, EMF, wetlands, wildlife)
New Components	7 Increase the capacity of transmission components (e.g., conductors, transformers, towers, insulators, underground cable, etc.)



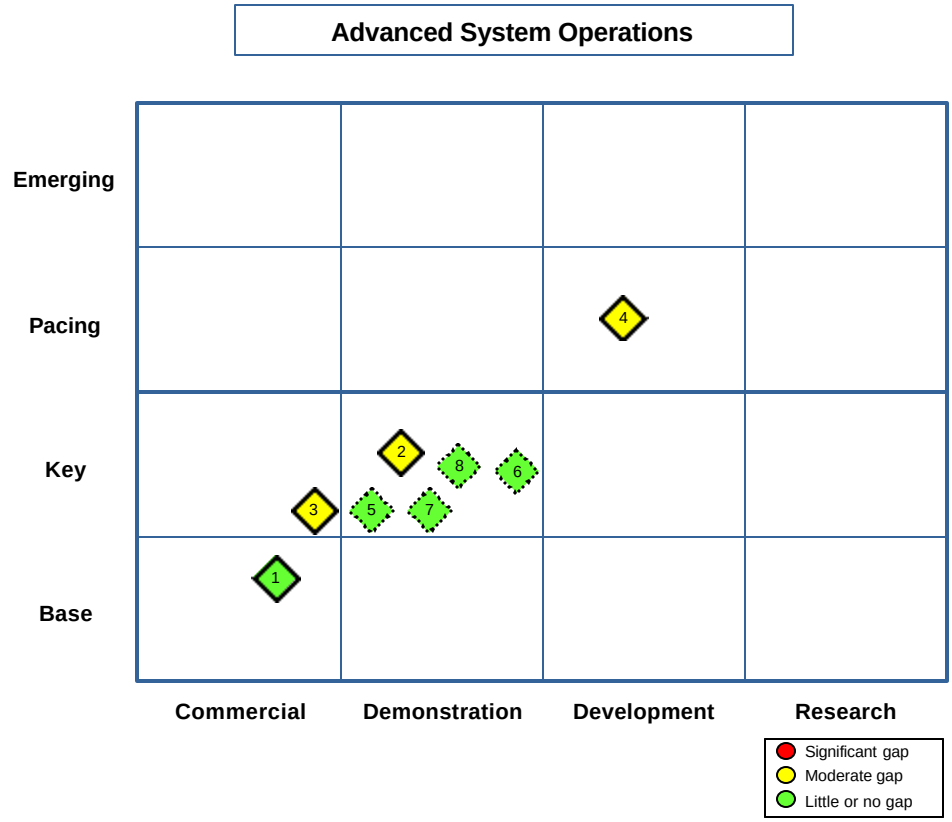
Advanced System Operations

Research initiatives within Advanced System Operations are focused on increasing transmission capability by making the system easier to operate, and facilitating reduced operating margins. Technologies in this are include information technology systems and software tools to enhance system information for operators.

- Research initiatives are generally Base/Key – Commercial/Demonstration
- There are generally little or no significant gaps given existing research initiatives
- One area worthy of additional attention is expert/automated systems for system control

Figure 4-4: Gap Analysis – Advanced System Operations

Research Initiatives – Advanced System Operations	
System Operability	1 Develop substation automation 2 Develop enhanced communications architecture 3 Integrate and streamline database and information systems 4 Develop expert systems to carry out complex control orders
Operating Information	5 Develop operating condition monitoring (e.g., power flow, voltage, temperature) 6 Develop presentation and communication tools for operators (e.g., outage mapping, congestion profiling) 7 Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling) 8 Develop tools for obtaining and presenting system information fo r planning purposes



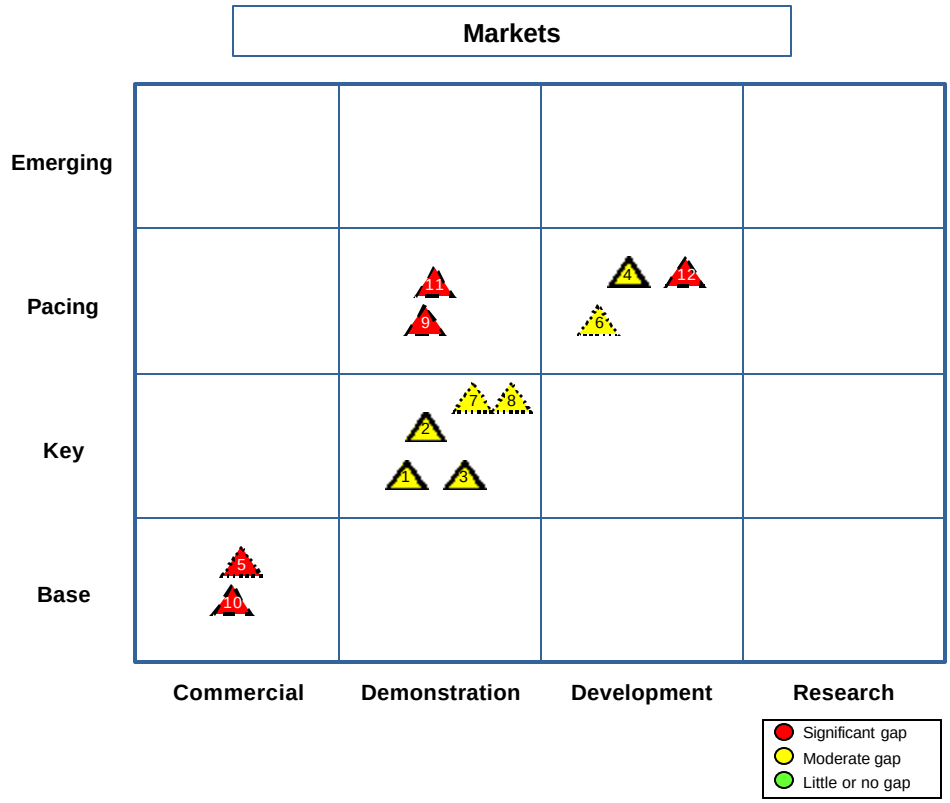
Markets

Research initiatives in the Markets focus area revolve around efforts to establish and refine the rules by which the various stakeholder groups interact to ensure the commercial and operational robustness of the electric power system. Issues in the Markets focus area include both technology and policy issues.

- The Markets area has moderate to significant gaps across the three sub-areas
- While there is activity in this area, information obtained during interviews indicates that important gains must be made to bridge the gaps
- Research and development on policies affecting transmission appears to be at least as important as technology R&D

Figure 4-5: Gap Analysis – Markets

Research Initiatives – Markets	
Market Design	1 Develop mechanisms to value and assign capacity rights 2 Determine appropriate ancillary services 3 Develop effective hedging instruments 4 Develop modeling tools to test and simulate markets
Market Operations	5 Identify ISO and Transmission Ownership requirements 6 Provide information and analysis to support bidding strategies 7 Develop systems to ensure transaction compliance 8 Develop rules and systems for congestion management
Business Models	9 Determine how to make money on transmission 10 Determine the best way to regulate transmission 11 Determine optimal ownership of transmission 12 Develop transmission value network



Chapter 5: Observations and Opportunities

Initial Assessment

- There are gaps in transmission R&D
- Transmission is a mature technology as evidenced by the level of the activity in the Key/Base area, and industry players appear to focus on improving cost performance and service reliability through incremental improvements
- Transmission technologies and the associated R&D in this area are expensive, resulting in a predominance of consortium projects

Potential Drivers of Observed Activity

- This is a mature industry
- Transmission as a sector is capital-intensive
- There may be low availability of capital versus required capital costs
- There are significant perceived levels of uncertainty and risk
- Competitive dynamics appear skewed, with market and business models creating instability or retarding investment. Therefore the market and business model gaps could be critical because they will create better understanding of the rules

Identification of R&D Opportunities

With the completion of the R&D assessment, the ESI will begin the work of developing a portfolio of projects and initiatives as part of its 5-year research plan for public interest in transmission. The following is an initial identification of R&D opportunities that will flow into the portfolio development process.

Items to be considered for the Portfolio are selected using a staged approach:

- Screen the full set of research initiatives to exclude those with little or no gap. The remaining initiatives become the opportunities.
- Items to be considered for the Portfolio are selected using a staged approach:
  - Select any opportunities that are considered “High Priority”. These automatically become part of the initial portfolio.
  - The remaining opportunities are further analyzed against the PIER Criteria and other strategic criteria to determine the higher value items that will be included in the initial portfolio.

The initial portfolio is designed by applying strategic considerations to the items selected above

Figure 5-1: Initial Set of Potential Research Initiatives to Support

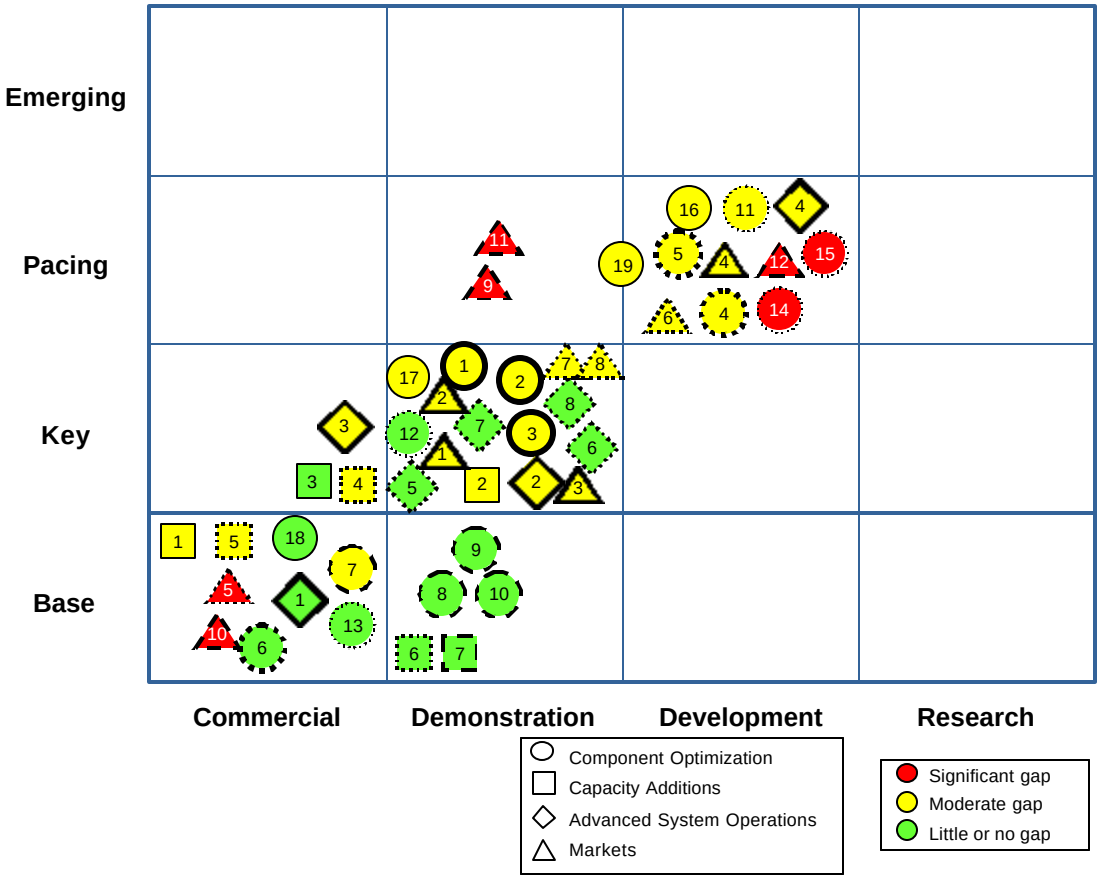
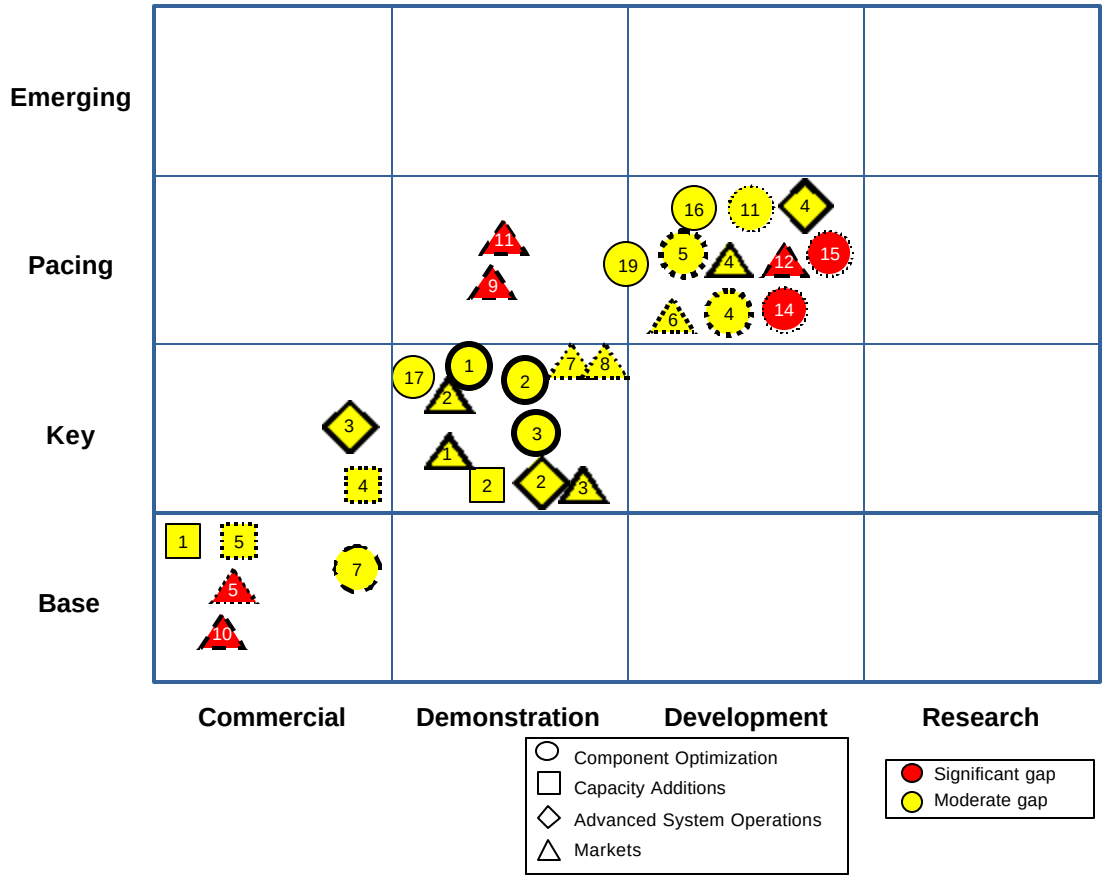


Figure 5-2: Screened Set of Potential Research Initiatives to Support

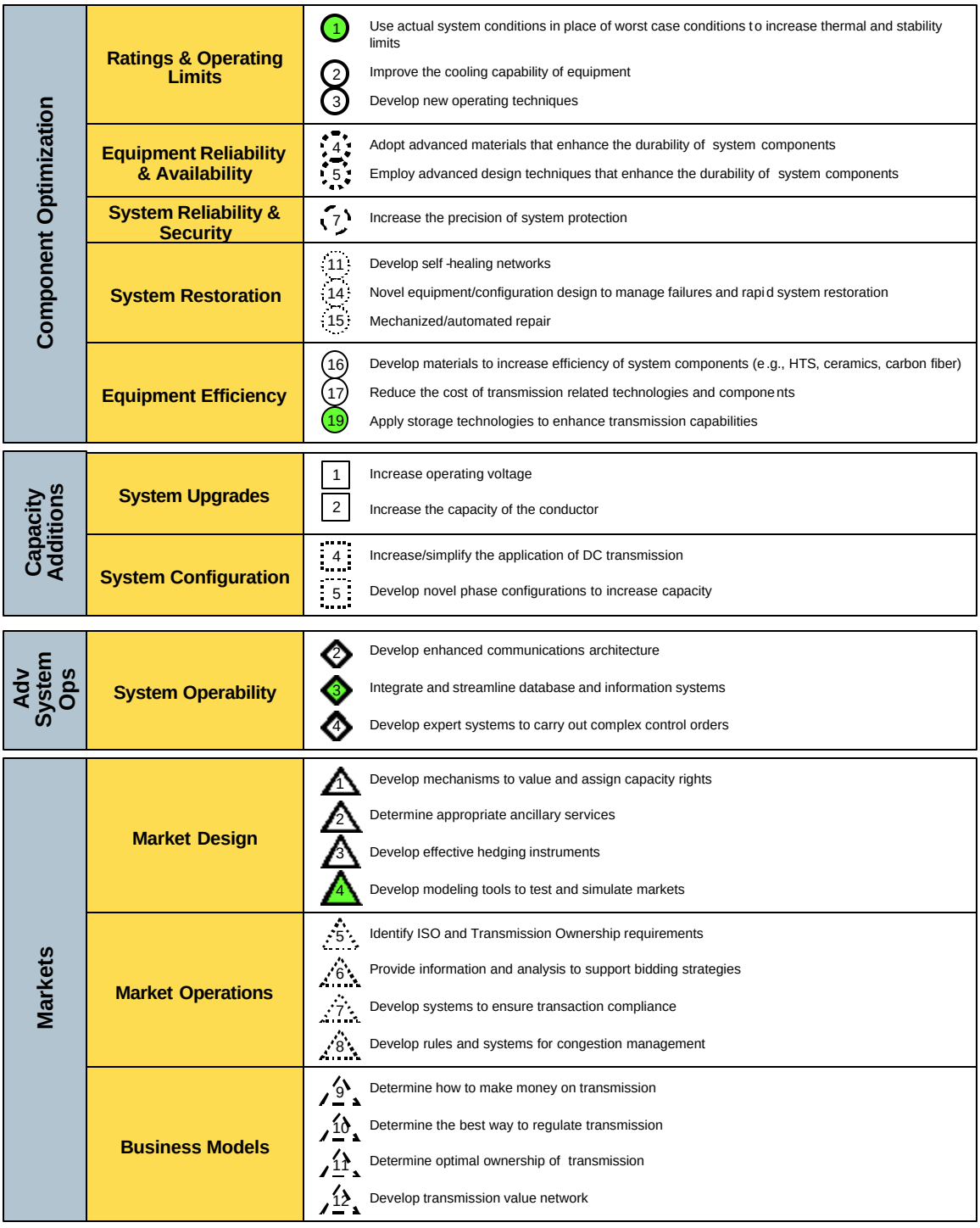


Initial high priority opportunities were selected based on several criteria:

- Opportunities that clearly meet all four CEC/PIER funding criteria
- Opportunities believed to be lower risk, falling within the Base/Key regions
- Opportunities that appear to offer benefits to a relatively diverse stakeholder group, or that may be applicable to other CEC programs
- Opportunities that are considered technical in nature rather than related to policy
- Opportunities that, if successful, could create a large overall impact
- Opportunities for which the CEC can make a real impact by its participation

Figure 5-3 shows initiatives that met all of the above criteria and were initially selected as High Priority. These initiatives are colored green.

Figure 5-3: Selecting Initial High Priority Opportunities



The initial high priority opportunities are those that can flow directly into the CEC portfolio of initiatives/projects in transmission (Figure 5-4).

Figure 5-4: Initial High Priority Opportunities for CEC Portfolio Consideration

High Priority Opportunities		
Component Optimization	1	Use actual system conditions in place of worst case conditions to increase thermal and stability limits
	19	Apply storage technologies to enhance transmission capabilities
Advanced System Operations	3	Integrate and streamline database and information systems
Markets	4	Develop modeling tools to test and simulate markets

The other opportunities identified in this research assessment are also candidates for the CEC portfolio, and may be selected based on strategic criteria developed by the CEC (Figure 5-5).

Figure 5-5: Other Opportunities for the CEC Portfolio

Other Opportunities

Component Optimization

2	Improve the cooling capability of equipment
3	Develop new operating techniques
4	Adopt advanced materials that enhance the durability of system components
5	Employ advanced design techniques that enhance the durability of system components
11	Develop self-healing networks
14	Novel equipment/configuration design to manage failures and rapid system restoration
15	Mechanized/automated repair
16	Develop materials to increase efficiency of system components (e.g., HTS, ceramics, carbon fiber)
17	Reduce the cost of transmission related technologies and components

Capacity Additions

2	Increase the capacity of the conductor

Advanced System Operations

2	Develop enhanced communications architecture
4	Develop expert systems to carry out complex control orders

Markets

1	Develop mechanisms to value and assign capacity rights
2	Determine appropriate ancillary services
3	Develop effective hedging instruments
5	Identify ISO and Transmission Ownership requirements
6	Provide information and analysis to support bidding strategies
7	Develop systems to ensure transaction compliance
8	Develop rules and systems for congestion management
9	Determine how to make money on transmission
10	Determine optimal ownership of transmission
11	Determine the best way to regulate transmission
12	Develop transmission value network

These initial High Priority and Other Opportunities provide CEC PIER with a wide range of potential R&D investment areas in the transmission arena. Selection of the best investment areas will depend on the specific criteria used by the CEC to prioritize the opportunities, the available CEC funding and the extent of risk sharing and collaboration that are employed. These crucial decisions and the development of an overall plan for Transmission R&D will be addressed by CEC PIER in the near future.

Appendix A: Component Optimization Projects

The following projects have Component Optimization as their primary focus area.

1. CEC-Real-Time Ratings for Path 15

2. CEC-Development of a Composite Reinforced Aluminum Conductor I

3. CEC-Development of a Composite Reinforced Aluminum Conductor II

4. CEC-Sagging Line Mitigator (SLIM)

5. CEC-Dynamic Circuit Thermal Line Rating (DCTR)

6. CEC-EPRI Target 39: Grid Operations & Management

7. CEC-Bird Strike Monitor

8. CEC-Wildlife Interactions with Utility Facilities

9. CEC-Habitat and Species Protection

10. CEC-EPRI Target 57.1 Mitigation of Avian Interactions with Utility Structures

11. CEC-Electric System Seismic Safety and Reliability I

12. CEC-Electric System Seismic Safety and Reliability II

13. EPRI-CEIDS Self-Healing Grid

14. EPRI-Bushing Power Factor Testing (1006767)

15. EPRI-Distributed Fiber Optic Temperature Sensor (TO-111617)

16. EPRI-Dynamic Thermal Circuit Rating (TO-111997)

17. EPRI-Electrical Condition Assessment of Polymer Insulators for Live Working (1007368)

18. EPRI-EPRI Cable Testing Network (ECTN) (1007364)

19. EPRI-Testing for Gassing Sites in Power Transformers Using an Acoustic Emissions Technique (1001229 and 1007369)

20. EPRI-Infrastructure Security Initiative (1007051)

21. EPRI-Life Evaluation of In-Service, Pipe-Type Cable Systems (111949)

22. EPRI-MMW-Lessons Learned and Business Benefits (1006232)

23. EPRI-Field Evaluation of Two New EPRI Tools for On-Site SF6 Analysis (1007003)

24. EPRI-Partial Discharge Detection, Location and Characterization in Transformers (1001276)

25. EPRI-Power System-Railroad EMC (1006718)

26. EPRI-2-day Seminar on PTLoad 6.0 (1007352)

27. EPRI-Seismic Qualification of Substation Equipment Using IEEE 693 (1006237)

28. EPRI-Sen Transformer (ST) (1007581)

29. EPRI-SF6 Leak Sealing (1007002)

30. EPRI-Sagging Line Mitigator (SLiM) (1007295)

31. EPRI-Development and Field Trial of a Solid State Current Limiter (1006166 and 1007303)

32. EPRI-Transfer Capability Evaluation (TRACE) Program (1007242)

33. EPRI-Moisture Assessment and Ranking of Power Transformers (1007068)

34. EPRI-Transmission Inspection and Maintenance (TIM) System (111875)

35. EPRI-Uninterruptible Substation (TO-112011)

36. EPRI-Power Quality Improvement Methodology for Wires Companies (051688)

37. EPRI-Vibration Management of Overhead Transmission Lines (055812)

38. EPRI-Enhanced Non-Ceramic Insulator (NCI) Performance (051993)

39. EPRI-Demonstration of 345 kV XLPE Cable System (051985)

40. EPRI-Novel and Low Cost Techniques to Measure Temperature of Conductors, Transformers and Cables (051835)

41. EPRI-Technology Development of Energy Storage Options for Improved T&D Asset Utilization (051557)

42. EPRI-Energy Storage to Mitigate Stability Limited Transmission Systems (051554)

43. EPRI-Avian Interactions With Power Structures, Wind Turbines and Communication Towers (101940)

44. PSERC-Electrical Transmission Line Insulator Flashover Predictor (T-4)

45. PSERC-Condition Monitoring and Maintenance Strategies for In-Service Non-Ceramic Insulators (NCI), Underground Cables and Transformers (T-6)

46. PSERC-Redesign and New Interpretation of Power Acceptability Curves for Three Phase Loads (T-7)

47. PSERC-Investigation of Fuel Cell Operation and Interaction within the Surrounding Network (T-8)

48. PSERC-Voltage Collapse Margin Monitor (S-2)

49. PSERC-Impact of Protection Systems on Reliability (S-4)

50. PSERC-Integrated Security Analysis (S-7)

51. PSERC-Coordination of Line Transfer Capability Ratings (S-8)

52. PSERC-Intelligent Substation (T-5)

53. PSERC-Accurate Fault Location in Transmission and Distribution Networks Using Modeling, Simulation and Limited Field-Recorded Data (T-10)

54. PSERC-Evaluation of Critical Components of Nonceramic Insulators (NCI) In-Service: Role of Seals and Interfaces (T-14)

55. PSERC-Voltage Dip Effect on Loads in Electric Power System (T-16)

56. PSERC-Automated Integration of Condition Monitoring with an Optimized Maintenance Scheduler for Circuit Breakers and Power Transformers (T-19)

57. PSERC-Fault Location Using Sparse Data and Wireless Communications for Collection of PQ Data in the TVA System (T-21)

58. PSERC-Steady State Voltage Security Margin Assessment (S-11)

59. PSERC-Comprehensive Power System Reliability Assessment (S-13)

60. PSERC-Detection, Prevention and Mitigation of Cascading Events (S-19)

61. CERTS-Grid of the Future White Papers

62. CERTS-U.S. Department of Energy Power Outage Study Team

63. IEEE-CERTS Conference: Ensuring Electric Power Reliability-The Challenges Ahead

64. Sandia National Labs-Energy and Critical Infrastructure Program

65. Oak Ridge National Labs-Composite Conductor Project

66. Oak Ridge National Labs-Superconductor Transformer Project

67. Oak Ridge National Labs-Superconductor Cable Project

68. American Superconductor-Superconductor Cable Project

69. American Superconductor-SMES Project

70. Tennessee Valley Authority-Online Tension Monitoring Project

71. Tennessee Valley Authority-Transformer Project

72. Tennessee Valley Authority-Main Improvement Line Extension (MAIN) Project

73. Tennessee Valley Authority-CVD Diamond Project

74. California ISO-AGC Regulation by EV / Battery

75. California ISO-Reliability Initiative

76. California ISO-Dynamic Thermal Circuit Rating (DTCR)

77. California ISO-Energy Storage Technologies

78. BPA-Equipment Research

79. Superconductor Cable

80. BC Hydro-NxtPhase Optical Voltage & Current Sensors Demonstration

81. BC Hydro-Life Extension of Transformer Paper by In-Situ Restoration of Additives: Role of Dicyandiamide (DICY) in Thermally Upgraded Transformer Paper

82. BC Hydro-Oil Leak Detection in Submarine Cables Via Tracer Compounds

83. BC Hydro-Performance Evaluation of In-Service Four-Bundle Spacer Dampers

84. BC Hydro-Computer Assisted Diagnostics, Condition Assessment and Life Extension of Substation Equipment (Apparatus Assessment Assistant) – LABSYS

85. BC Hydro-Development of Small Signal Analysis Tool (SSAT)

86. BC Hydro-Feasibility of Microwave Radiometry for Monitoring Porcelain and Polymer Substation Equipment – Proof-of-Concept for Bushings, CTs and CVTs

87. BC Hydro-Develop a Maintenance Strategy for Coating Below Ground Components of Galvanized Steel Towers

88. BC Hydro-Transmission Line Surge Arresters

89. Mitigation of Squirrel-Related Power Outages

1. CEC-Real-Time Ratings for Path 15

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project examines the feasibility of providing real-time transmission line ratings by monitoring the conductor tension and environmental factors for a multiple transmission line path and communicating the real-time data to PG&E and the ISO. This project also provides a calculated real-time rating for the path directly to the system operators.	Can the ratings of existing equipment/components be increased? How can we improve the quality and quantity of operating information?	• Use actual system conditions in place of worst case conditions to determine thermal and stability limits • Develop operating condition monitoring (e.g., power flow, voltage, temperature)	•Develop software and procedures to allow an increase of thermal capacity of Path 15; and Verify the applicability of such hardware, software and methods for use on other thermally limited paths and single circuits in California.

Funding/Source	Participants	Point of Contact
CEC: **$369,204 (700-00-006)**	The Valley Group and Niskayuna Power Consultants, Power Delivery Consultants, Pacific Gas and Electric Company (PG&E) and the California Independent System Operator (ISO).	**The Valley Group Project Manager:** Tapani Seppa (203) 431-0262 **The Valley Group Project Contact:** Timo Seppa (203) 431-0262 Commission Contract Manager: **Don Kondoleon (916) 654-3918**

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Ratings & Operating Limits	Key	Demonstration

2. CEC-Development of a Composite Reinforced Aluminum Conductor I

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project will develop a composite reinforced aluminum conductor (CRAC) to replace conventional conductors made from aluminum wires wrapped over a core of steel strands (called aluminum conductor - steel reinforced (ACSR) conductors). The results should help improve the reliability and capability of California's transmission and distribution system.	•Can we increase the efficiency of system components? Can technology be applied to increase the reliability and/or availability of equipment?	• Develop materials to increase efficiency of system components (e.g., HTS, ceramic, carbon fiber). • Adopt advanced materials that enhance the durability of system components • Employ advanced design techniques that enhance the durability of system components	•Two CRAC, CRAC-121 (one-to-one) and CRAC-Advanced, were developed during this project. •Splicing techniques were developed and demonstrated for both CRAC. •A splicing tool was developed to splice the composite strength member.

Funding/Source	Participants	Point of Contact
CEC: $75,000 (500-98-035) **Match Funding:** $185,000 (Los Angeles Regional Technology Alliance $65,000; DOE-Energy Inventions and Innovations $55,000; WBG&AI $65,000)	W. Brandt Goldsworthy & Associates, Inc.	**Contractor Project Manager:** W. Brandt Goldsworthy (310) 375-4565 **Commission Contract Manager:** Linda Davis (916) 654-3848

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Efficiency, Equipment Reliability & Availability	Pacing	Development

3. CEC-Development of a Composite Reinforced Aluminum Conductor II

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This follow-on research will develop prototype-manufacturing technology for CRAC and demonstrate the conductor's performance on a 2,000-foot (nominal) 3-phase span using Southern California Edison's facilities. Phase II will also evaluate manufacturing process improvement concepts which may fundamentally affect the CRAC-TelePower conductor price and quality.	•Can we increase the efficiency of system components? Can technology be applied to increase the reliability and/or availability of equipment?	• Develop materials to increase efficiency of system components (e.g., HTS, ceramic, carbon fiber). • Adopt advanced materials that enhance the durability of system components • Employ advanced design techniques that enhance the durability of system components	The goal of this project is to design, develop and demonstrate a combined transmission line power and data transfer concept. Successful demonstration of this concept also includes developing and demonstrating new manufacturing methods needed to make it cost-competitive.

Funding/Source	Participants	Point of Contact
CEC: $1,100,479 (500-00-003) **Match Funding:** $325,000	W. Brandt Goldsworthy & Associates, Inc.	**Contractor Project Manager:** W. Brandt Goldsworthy (310) 375-4565 **Commission Contract Manager:** Jamie Patterson (916) 657-4819

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Efficiency, Equipment Reliability & Availability	Pacing	Development

4. CEC-Sagging Line Mitigator (SLIM)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of the SLIM project will develop and test a sagging line mitigator to automatically counteract the sagging of high voltage transmission lines due to high ambient temperature and current flows. The product has the potential to revolutionize treatment of overhead transmission lines for both retrofitting of existing lines and construction of new lines.	Can we reduce the operating margins of the system? Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Develop new operating techniques • Reduce the impact of environmental conditions (e.g., lightning, fire, storm, salt) and terrorism	•Complete design and analysis work for the proposed SLIM device •Conduct rigorous prototype testing for applicability; proof of concept and design refinements •Develop manufacturing plans for the SLIM device

Funding/Source	Participants	Point of Contact
CEC: $900,000 (500-98-042); **Match Funding:** $78,920	Material Integrity Solutions, Inc. (MIS) and Dr. Duch Hai Nguyen of Hydro Quebec (IREQ); Dariush Shirmohammadi, Ph.D.; Expert Power Engineering Consultant.	**Contractor Project Manager:** Dr. Manuchehr Shirmohamadi (510) 594-0300 x202 **Commission Contract Manager:** David A. Chambers (916) 653-7067

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Key	Demonstration

5. CEC-Dynamic Circuit Thermal Line Rating (DCTR)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this project was to develop and demonstrate real-time transmission line ratings. DCTR uses equipment mounted on a transmission tower to monitor the line conductor tension and determine ground clearances and weather conditions to calculate the amount of current that can be transmitted in real time. This information is provided to system operators or engineers in system operation.	Can the ratings of existing equipment/components be increased? How can we improve the quality and quantity of operating information?	• Use actual system conditions in place of worst case conditions to determine thermal and stability limits • Develop operating condition monitoring (e.g., power flow, voltage, temperature)	• Increase transmission capacity on congested transmission lines to allow increased power transfers. • Reduce use of expensive generators which "must run" due to transmission rating constraints. • Promote the use of more economic generators to result in reduced energy system price for utility customers.

Funding/Source	Participants	Point of Contact
CEC: $110,000 (500-97-011)	San Diego Gas and Electric (SDG&E)	**Contractor Project Manager: Bill Torre (619) 696-4880** **Commission Contract Manager**: Linda Davis (916) 654-3848

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Ratings & Operating Limits	Key	Demonstration

6. CEC-EPRI Target 39: Grid Operations & Management

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this project is to support EPRI's collaborative program in Grid Operations and Management, which is developing new tools and information that can be used to more efficiently and reliably operate the electricity power grid in California and the western region.	• Can we increase the efficiency of system components? •How can we improve the integration of power system components? •What are the anticipated values/benefits of improved system operations?	• Reduce the cost of transmission related technologies and components • Integrate and streamline database and information systems	•Provide software and information to reduce the costs and improve the efficiency of control center operation. •Provide software, methods, and information to enhance the transaction without impact on security.

Funding/Source	Participants	Point of Contact
CEC: $201,923 (100-98-001 #1) **Match Funding:** $5,156,709	EPRI; ABB Power T&D; Best Systems; Bonneville Power Administration (BPA); Decision Systems International; Hoffman Publications; Incremental Systems; Iowa State Univ.; Michael Terbrueggen, dba; Quality Training Systems; Xtensible Solutions	**EPRI:** Stephen Lee 650/855-2486 **CEC:** Don Kondoleon 916/654-3918

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization, Advanced System Operations	Equipment Efficiency, System Operability	Key	Demonstration / Development

7. CEC-Bird Strike Monitor

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this project was to develop an efficient and cost-effective system to detect electric power-disrupting bird collisions with powerlines using a wire-trip mechanism. This system is designed to provide power line owners with the tools necessary to identify the power lines responsible for multiple bird collisions, without spending excessive time or money for reconnaissance.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism? How can we improve the quality and quantity of operating information?	• Reduce the impact of environmental conditions (e.g., lightning, fire, storm, salt) and terrorism • Develop operating condition monitoring (e.g., power flow, voltage, temperature)	•Develop an affordable, reliable and proven device to detect bird collisions with electrical transmission and distribution wires. ••Help identify locations along transmission and distribution lines with high incidence of bird collisions. ••Modify transmission and distribution lines to reduce collision risk. ••Reduce the incidence of temporary power outages.

Funding/Source	Participants	Point of Contact
CEC: $100,000 (500-97-010-05)	Pacific Gas and Electric (PG&E)	PG&E: Sheila Byrne, (510) 866-5987 CEC: Linda Speigel, (916) 654-4703

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Demonstration

8. CEC-Wildlife Interactions with Utility Facilities

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this project was to analyze products that reduce or prevent wildlife interactions, and resulting electrocutions and power outages, with power lines and power facilities.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Reduce the impact of environmental conditions (e.g., lightning, fire, storm, salt) and terrorism	•Distribution line add-on insulation and perch deterrent products added to distribution line power poles were analyzed to evaluate their durability and effectiveness. •GIS tools to identify "high risk" areas were also evaluated.

Funding/Source	Participants	Point of Contact
CEC: $130,000 (500-97-010-08)	Pacific Gas and Electric with Colson and Associates	PG&E: Mark Dedon, (510) 866-5829 CEC: Rick York, (916) 654-3945

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Demonstration

9. CEC-Habitat and Species Protection

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The goal of this project was to minimize raptor mortality (and resulting electric power disruptions) associated with power lines by identifying where and why this mortality occurs and then developing recommendations to minimize these impacts.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Reduce the impact of environmental conditions (e.g., lightning, fire, storm, salt) and terrorism.	•Improving environmental and public health costs/risk of California's electricity by developing methods to minimize the environmental impact of power facilities on sensitive species and habitats; and •Improving the reliability/quality of California's electricity by reducing bird-related power outages.

Funding/Source	Participants	Point of Contact
CEC: $525,000 (500-97-012-05)	Edison Technology Solutions (ETS) and Electric Power Research Institute (EPRI); Ed Almanza and Associates; University of California, Irvine; Premier Temporary Service; Bio Resources Consulting; Positive Systems; Applied Biomathematics	Edison Technology Solutions: Dan Pearson, (626) 302-9562 CEC: Marc Sazaki, (916) 654-5061

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Demonstration

10. CEC-EPRI Target 57.1 Mitigation of Avian Interactions with Utility Structures

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this project is to mitigate and reduce avian fatalities and increase power reliability. Avian interactions (i.e. collisions and electrocutions) with overhead power lines, wind turbines, communication towers, and other utility structures can disrupt service and/or adversely affect bird populations.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Reduce the impact of environmental conditions (e.g., lightning, fire, storm, salt) and terrorism.	PIER and EPRI are developing and testing automated avian monitors to address the need to gather collision and electrocution information that is difficult and costly to obtain, to help standardize monitoring methods, and to evaluate the efficacy of bird deterrent devices.

Funding/Source	Participants	Point of Contact
CEC: $100,000 (500-00-023) Matched Funding: $50,000	Electric Power Research Institute (EPRI), EDM Inc.	EPRI: Richard Carlton, (650) 855-2115 CEC: Linda Spiegel (916) 654-4703

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Demonstration

11. CEC-Electric System Seismic Safety and Reliability I

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this project was to support several major research projects in the field of electric system seismic safety and reliability. Projects ranged from the shake table testing of electric bushings and the collection of soil data at existing substations, to the development of a rapid response, strong ground shaking contour map program and related strong ground motion attenuation curves.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Design systems/ system components to withstand seismic events	•Improvements to installed utility equipment will be identified and tested •Develop improved assessments of shaking-caused permanent ground deformation hazards •Examine the process of fire initiation during power restoration following earthquakes •Develop the capability to analyze data from distant seismographic instruments

Funding/Source	Participants	Point of Contact
CEC: **$1,000,000 (500-97-010)**	Pacific Gas and Electric Company and University of California, Berkeley Pacific Earthquake Engineering Research Center (PEER)	**Contractor Project Manager:** Dr. William (Woody) Savage (415) 973-3116 **Commission Contract Manager: Robert Anderson (916) 654-3836**

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Demonstration

12. CEC-Electric System Seismic Safety and Reliability II

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this contract is to fund user-driven research to support the development and rapid application of methods and technologies for reducing earthquake hazards and vulnerability, and improve electric system reliability and safety of electric transmission and distribution systems. This contract is a continuation of the successful research conducted under contract No. 500-97-010.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Design systems/ system components to withstand seismic events	•As of 11/27/01 we have fifty-one active research projects covering the following topic areas: •Earthquake Ground Motion •Site Response •Permanent Ground Deformation •Seismic Performance of Substation Equipment •Electric System Building Vulnerability •Network System Seismic Risk •Emergency Response.

Funding/Source	Participants	Point of Contact
CEC (700-99-002): **$3,000,000 (1999/00) $1,500,000 (2000/01) Match Funding: $1,000,000 (PG&E) $4,500,000 (CalTrans)**	Pacific Gas & Electric (PG&E) and the Pacific Earthquake Engineering Research Center (PEER)	**Contractor Project Manager:** Dr. William (Woody) Savage (415) 973-3116 **Commission Contract Manager: David A. Chambers, (916) 653-7067**

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Demonstration

13. EPRI-CEIDS Self-Healing Grid

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
•Expand and enhance the Wide Area Measurement System (WAMS) •Develop a high-voltage fault anticipator •Develop ultra-fast pattern recognition to categorize and identify threats •Create intelligent islanding schemes that will separate the system into self-sustaining parts •Develop auto-recovery systems to reconnecting the grid •Develop secure control and communications protocols •Develop methods and technologies for distributed control and self-regulation	Can we decrease the time required to restore failed components? •What are the anticipated values/benefits of improved system operations?	• Develop self-healing networks • Improve fault location identification to decrease restoration time • Mechanized/automated repair • Develop enhanced communications architecture	Development of the following technologies to enable a "self healing" infrastructure: •Sensors •Communications •Adaptive relaying •Load shedding control •Generator control •Adaptive islanding •Distributed intelligence

Funding/Source	Participants	Point of Contact
Public/Private Partnership	EPRI	Marek Samotyj (650) 855-2980 msamotyj@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Restoration	Pacing	Development

14. EPRI-Bushing Power Factor Testing (1006767)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project involves the comparison of a new technique for power factor measurement at rated voltage with the standard off-line test on bushings and HVCTs. The on-line factor tests will use the PF Live equipment and software tool developed by AVO International. If successful, an on-line factor measurement tool may be able to provide more accurate readings and predict impending failures.	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance)	•Report from EPRI consolidating and comparing data from all installed locations. Conclusions will help guide members in developing their maintenance schedules.

Funding/Source	Participants	Point of Contact
Assuming 3 participants (utility sites) and 6 installations, the cost per participant will be $4500 for the first installation and $2500 for each subsequent installation.	EPRI, utility participants	Barry Ward (650) 855-2717 baward@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Key	Demonstration

15. EPRI-Distributed Fiber Optic Temperature Sensor (TO-111617)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Fiber optic temperature sensors inserted along a power cable allow for more accurate ampacity calculations by engineers, increasing the allowable operating capacity to reflect actual line capability. Participants will have the opportunity to optimize the capacity of underground distribution and transmission circuits, thereby deferring costly upgrades.	Can the ratings of existing equipment/ components be increased? Can we reduce the operating margins of the system? Can the system be modified to meet changing conditions?	• Use actual system conditions in place of worst case conditions to determine thermal and stability limits	•Refine methods and equipment for safely installing the fiber optic cable •Suite of DFO sensors that can be used for detecting leaks and failures in addition to measuring temperature •Develop lower-cost multi-function inferometers for processing and analyzing signals from the optical fiber cables

Funding/Source	Participants	Point of Contact
Up-front cost of $200,000 and $10,000 for each one week circuit profiling (2 profiles/year expected)	EPRI, Southern California Edison, Consolidated Edison	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Ratings & Operating Limits	Key	Demonstration

16. EPRI-Dynamic Thermal Circuit Rating (TO-111997)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
EPRI's Dynamic Thermal Circuit Rating (DCTR) software and hardware tools provide low-cost methods for increasing power transfer capabilities of various transmission and substation equipment by 5-15%. The DCTR tools accomplishes this by providing real-time predictions of dynamic thermal ratings that can be used by system operators to better manage line loading.	Can the ratings of existing equipment/components be increased? How can we improve the quality and quantity of operating information?	• Use actual system conditions in place of worst case conditions to determine thermal and stability limits • Develop operating condition monitoring (e.g., power flow, voltage, temperature)	•DCTR software running on Windows NT •Technical support

Funding/Source	Participants	Point of Contact
A field test would cost between $150,000 and $250,000	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Ratings & Operating Limits	Key	Commercial

17. EPRI-Electrical Condition Assessment of Polymer Insulators for Live Working (1007368)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
EPRI is working to develop testing methods to polymer insulators to provide linemen with added reassurance that polymer insulators will not fail during live work. One method holding promise involves the use of a short metal shunt to test the polymer insulator prior to live work, but more research is needed. The focus is on double-circuit 230kV steel lattice structures.	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance)	•A written report with photographs and test results •Recommendations regarding the use of the shunt •Comparison of the shunt method against other methods

Funding/Source	Participants	Point of Contact
$120,000 a year for two years, assuming 3 participants	EPRI	Ray Lings 650-855-2177 rlings @epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Commercial

18. EPRI-EPRI Cable Testing Network (ECTN) (1007364)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
ECTN will provide new tools to assess the condition of aging distribution cables and enable participants to optimize their replacement strategies. Many paper-insulated lead-covered (PILC) cables are experiencing increasing failure rates due to age, and utilities need to have better tools to assess their condition.	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance)	•Conduct collaborative research and testing related to distribution cables •Develop new test procedures •Optimize cable replacement strategies •Determine technical life of PILC cables •Provide technical support

Funding/Source	Participants	Point of Contact
$200,000/year - Executive Level $125,000/year - Full Level	EPRI	Walter Zenger (413) 448-2424 wzenger@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Commercial

19. EPRI-Testing for Gassing Sites in Power Transformers Using an Acoustic Emissions Technique (1001229 and 1007369)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
A new Acoustic Emissions (AE) technique shows promise for the detection, location, and characterization of gassing sources in power transformers. Phase I of the project involved testing over 60 transformers to build a database and system of classification for gassing faults. Phase II, now underway, will build on that database, refine the classification system, and extend the technique to load tap changers and circuit breakers.	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance)	Phase I •Initial database to relate acoustic emission signal patterns to severity and type of fault •Development of a plan to enhance the location software based on the analyzed data Phase II •Increased insight into gassing source characterization techniques •Refined database of gassing fault types

Funding/Source	Participants	Point of Contact
EPRI, $25,000-$40,000 in Phase I for each of the seven major utilities participating	EPRI, Physical Acoustics, seven major utilities	Barry Ward (650) 855-2717 baward@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Availability and Reliability	Base	Demonstration

20. EPRI-Infrastructure Security Initiative (1007051)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The EPRI Infrastructure Security Initiative has four program areas: •Vulnerability assessment •Strategic spare parts inventory: collaborative inventory of long lead-time items •"Red Team" attacks: mock assaults on communications and information networks •Secure communications: identify secure alternatives to internet communications	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce the impact of environmental conditions (e.g., lightning, fire, storm, salt) and terrorism	•Improved awareness of security weaknesses •Enhanced readiness for emergencies

Funding/Source	Participants	Point of Contact
Members can participate in the ISI program through the Program Opportunity (PO) program.	EPRI	Massoud Amin (650) 855-2452 Mamin@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Demonstration

21. EPRI-Life Evaluation of In-Service, Pipe-Type Cable Systems (111949)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Accurate remaining life estimates of in-service pipe-type cables will help optimize maintenance, avoid failures, and maximize use of underground transmission assets. In this project, new life evaluation procedures will be developed and applied to aged in-service cable systems owned by TC participants.	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance)	•In-depth evaluation of the condition and remaining life of the participant's pipe-type cable systems based on previously derived relationships and rate equations for aging circuits. •Commercial tool/service for condition assessment and life evaluation of in-service pipe-type cables

Funding/Source	Participants	Point of Contact
Project cost depends on the scope of work, ie., the size of the underground network to be assessed and the desired degree of analytical detail	EPRI, Funders of the EPRI Underground Transmission Target	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Commercial

22. EPRI-MMW-Lessons Learned and Business Benefits (1006232)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Report on the experience of users of MMW. The report produced would incorporate both lessons learned and benefits and successes of the deployment of MMW. The following topics will be covered: •Maintenance practices •Resources/work force and spares policy •Maintenance budgets and its allocation •Equipment history	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance)	•A detailed report on the experience of utilities that have installed MMW •Through the sharing of information, individual installations could be enhanced

Funding/Source	Participants	Point of Contact
Total project cost is estimated at $40,000	EPRI	Tony McGrail (413) 448-2424 AMcGrail@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Key	Commercial

23. EPRI-Field Evaluation of Two New EPRI Tools for On-Site SF6 Analysis (1007003)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project involves the field testing of a portable SF6 by-product analyzer and a tailored portable Gas Chromatograph (GC) that allows for a rapid but complete assessment of the SF6. Participants will receive on-site training on two new EPRI SF6 Analysis devices, Site Assessment of SF6 in a selected substation, an Application Guide, and the option to retain the two new on-site SF6, evaluation tools.	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance)	•One-day site assessment of your SF6 equipment by EPRI at a substation of your choosing •On-site training and demonstration of the features of two EPRI SF6 Analyzers during the site assessment. •The option to retain the prototype tools •An application guide on SF6 analysis •A benchmarking report •Access to on-line SF6 database

Funding/Source	Participants	Point of Contact
If the participant wishes to own the equipment being tested, the cost is $74,000, including EPRI matching funds. If not, the total cost is $18,000, including EPRI matching funds.	EPRI	Luke van der Zel (413) 499-5012 Lvanderz@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Demonstration

24. EPRI-Partial Discharge Detection, Location and Characterization in Transformers (1001276)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The ability to detect, locate, classify and characterize partial discharges (pd) within transformers will impact on: •The need to have personnel in the vicinity of unreliable equipment •The cost of unexpected outages and consequent system constraints •Environmental effects of failures •Maintenance requirements for plant •Routine substation inspection	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive /predictive maintenance)	•Personal pd detectors for individual personnel issue on site where pd is a possibility, or where pd is suspected and closer investigation is required. •Acoustic/rf hand held devices to detect, characterize and locate pd sources •A radio antenna array to monitor for pd on a bay basis •Acoustic array for long term monitoring of individual units

Funding/Source	Participants	Point of Contact
Total project cost is $750,000	EPRI	Barry Ward (650) 855-2717 baward @epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Commercial

25. EPRI-Power System-Railroad EMC (1006718)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
EPRI's electromagnetic compatibility (EMC) program delivers information and tools for predicting, analyzing, and mitigating electromagnetic interference related to power systems facilities. This project will provide a practical handbook to guide investigation and resolution of problems involving electromagnetic compatibility between power facilities and the operation of railroad crossing signals.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Reduce the impact of environmental conditions and terrorism	•EPRI will publish a technical report in the form of a practical handbook for investigation and resolution of power system and railroad EMC problems •Throughout the project, participants will have access to the research team

Funding/Source	Participants	Point of Contact
Estimated project cost in 2002 is $300,000	EPRI	Michael Silva (650) 855-2815 Msilva@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Demonstration

26. EPRI-2-day Seminar on PTLoad 6.0 (1007352)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The intent of this project is to prepare and present a 2-day seminar on PTLOAD 6.0 to engineering personnel. PTLOAD 6.0 software offers a consistent flexible method of transformer rating calculation, based on IEEE and IEC standards. At least two test cases based on manufacturer's test data for transformers will be prepared.	N/A	• N/A	•At least 2 case studies wherein PTLOAD 6.0 is utilized to calculate the load capacity of transformers •Presentation of a 2-day seminar at the utility site, utilizing previously revised seminar notes for PTLOAD 6.0 and a written description of at least 2 case studies on transformers

Funding/Source	Participants	Point of Contact
$20,000 to $60,000 depending on customization of training session (includes EPRI matching funds)	EPRI	Steve Eckroad (650) 855-1066 seckroad@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Ratings & Operating Limits	Key	Commercial

27. EPRI-Seismic Qualification of Substation Equipment Using IEEE 693 (1006237)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The use of seismic qualification of substation equipment is one of the most cost-effective methods of reducing damage and disruption from earthquakes. A group approach to qualification will reduce cost and provide other benefits.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Design systems/system components to withstand seismic events	•A seismic qualification report for each item of equipment tested will be prepared by the consortium or the manufacturer and sent to all participants.

Funding/Source	Participants	Point of Contact
$10,000 for two years; costs will increase as project is extended based on participant needs	EPRI, BC Hydro, BPA, Chugach Electric Association, Hydro Quebec, NYPA, TVA, and WAPA	Ben Damsky (650) 855-2385 bdamsky@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Commercial

28. EPRI-Sen Transformer (ST) (1007581)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Based on proven technology that is inexpensive and reliable, successful field demonstrations of the Sen Transformer will give utilities vital information on a full-featured power flow controller that independently regulates the active and reactive power flow in a transmission line. This project will demonstrate the Sen Transformer on one operating transmission line.	Can we increase the efficiency of system components? Can we upgrade system elements to increase their capacity (e.g., voltage, conductor)?	• Reduce the cost of transmission related technologies and components • Increase transfer capabilities/limits	•Project review meetings and quarterly updates •Field test results •Final project report and workshop

Funding/Source	Participants	Point of Contact
Initial cost is estimated to be $4,000,000. This sum will be divided among all participants.	EPRI	Dr. Ram Adapa (650) 855-8988 Radapa@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization, Capacity Additions	Equipment Efficiency, System Upgrades	Key	Demonstration

29. EPRI-SF6 Leak Sealing (1007002)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project provides participants with a chance to submit details of sealing configurations in order to develop methods of effectively sealing SF6 leaks for 5-10 years without dismantling.	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/predictive maintenance)	•An application guide to SF6 leak sealing summarizing the research findings on optimal materials and techniques •Tailored guide on sealing materials and techniques for each participant's specific configuration •Full scale demonstration in a laboratory or an actual break, with verification using the EPRI SF6 camera

Funding/Source	Participants	Point of Contact
$20,000/participant per year for 2 years plus EPRI matching funds	EPRI	Luke van der Zel (413) 499-5012 Lvanderz@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Commercial

30. EPRI-Sagging Line Mitigator (SLiM) (1007295)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The Sagging Line Mitigator (SLiM) is a new class of transmission line hardware that fixes the problem by reducing excessive line sag at just the right time. SLiM reacts to increasing conductor temperature by decreasing the effective length of conductor in the span. Successful field demonstrations of SLiM will give utilities vital information on installing, operating, and maintaining these devices to significantly increase transmission capacity.	Can we reduce the operating margins of the system? Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Develop new operating techniques • Reduce the impact of environmental conditions (e.g., lightning, fire, storm, salt) and terrorism	•Project review meetings and quarterly reports •Field test results •Final project report and workshop

Funding/Source	Participants	Point of Contact
$70,000 per utility, including any applicable EPRI matching	EPRI	Dr. Ram Adapa (650) 855-8988 Radapa@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Key	Demonstration

31. EPRI-Development and Field Trial of a Solid State Current Limiter (1006166 and 1007303)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Instant response of solid-state power components makes it possible to produce a device that begins limiting fault current even before the first peak is reached, and added capabilities of this device will make possible valuable features and capabilities not possible with conventional technology. Field trials of transmission-class SSCL devices later in this project is also possible.	Can we decrease the time required to restore failed components?	• Novel equipment/ configuration design to manage failures and rapid system restoration	•A prototype device rated 1200 amperes suitable for field trial at medium voltage •A report on the performance of all field trials •Participants will obtain up-to-date information about the state of this new technology

Funding/Source	Participants	Point of Contact
$300,000 to $450,000 per utility	EPRI, Consolidated Edison, Allegheny Power, ISO New England	Ben Damsky (650) 855-2385 bdamsky@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Restoration	Pacing	Development

32. EPRI-Transfer Capability Evaluation (TRACE) Program (1007242)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Maximize utilization of transmission assets with fast, accurate evaluation of secure power transfer capability. TRACE is an advanced and versatile software package that determines the maximum power that can be transferred between defined portions of an interconnected power system.	Can we reduce the operating margins of the system? Can the system be modified to meet changing conditions?	• Use actual system conditions in place of worst case conditions to determine thermal and stability limits	•TRACE is available for implementation

Funding/Source	Participants	Point of Contact
There is a license fee and the overall price will vary depending on the utility's needs	EPRI, TVA, NERC	Peter Hirsch (650) 855-2206 phirsch@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Ratings & Operating Limits	Key	Commercial

33. EPRI-Moisture Assessment and Ranking of Power Transformers (1007068)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The moisture condition of power transformers is a critical parameter for safe and reliable operation. Proper assessment of moisture in paper is essential for an effective life extension program. Using EPRI software that incorporates moisture-in-paper algorithms called Transformer Moisture Monitor (TMM), utilities can obtain critical information gained through EPRI's research to apply at utility sites.	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance)	•Seminar to provide information on proper procedures and avoiding common pitfalls •Guidelines for on-line monitoring will be produced •Demonstration of the dry out process and TMM on one or more transformers

Funding/Source	Participants	Point of Contact
$50,000 to $150,000 (plus EPRI matching) per utility depending on the scope of activities	EPRI	Barry Ward (650) 855-2717 baward@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Commercial/Demonstration

34. EPRI-Transmission Inspection and Maintenance (TIM) System (111875)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Participants will gain even more strealined, efficient, and cost effective versions of the proven TIM system for inspection of overheard transmission lines. TIM is a integrated system that collects, maintains, and analyzes line inspection and maintenance data. Project opportunities exist in: •Implementation support •Addition of voice recognition capability •A Quick TIM version for aerial patrol inspections	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance)	•TIM office module for data analysis •TIM field module •TIM digital photography feature •Updated versions of TIM software

Funding/Source	Participants	Point of Contact
Contributions from utilities vary depending on the TIM-activities of interest up to $88,000 of TC funds per utility for participation in all three project opportunities	EPRI, San Diego Gas & Electric, Oklahoma Gas & Electric	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Commercial

35. EPRI-Uninterruptible Substation (TO-112011)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The UPS Substation will provide uninterruptible power at the substation level. Project participants can implement EPRI's UPS Substation that is typically installed at a large industrial customer served from a dedicated substation. The device integrates FACTS-type power electronics, storage and generation into a single "plug and play" package.	Can technology be applied to increase the reliability and/or availability of equipment? How can we improve the integration of power system components?	• Adopt advanced materials that enhance the durability of system components • Employ advanced design techniques that enhance the durability of system components • Develop substation automation	•Final engineering design of uninterruptible substation for host utility site •Prototype UPS Substation installed and operating at host utility site •Complete test program and data analysis provided by UPS Substation at host utility

Funding/Source	Participants	Point of Contact
Each demonstration costs between $5,000,000 and $15,000,000 depending on the size and options exercised	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Key	Demonstration

36. EPRI-Power Quality Improvement Methodology for Wires Companies (051688)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project will develop a guidebook that can be used to investigate, solve, and/or prevent common power quality problems using traditional transmission and distribution methods and equipment. The guidebook includes technical and economic considerations for application of power quality improvement methods for the wires company.	N/A	• N/A	•Report due in March 2003

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Commercial

37. EPRI-Vibration Management of Overhead Transmission Lines (055812)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Reduce maintenance and capital cost by optimal placement of dampers on conductors. Identify and perform cost effective maintenance on components damaged by vibration prior to failure. Finally, ensure capture of knowledge through the updating of the Transmission Line Vibration Handbook.	Can technology be applied to increase the reliability and/or availability of equipment?	• Employ advanced design techniques that enhance the durability of system components • Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance)	•LINE VIBRATION 2.0: Damper Placement Software, Software (1002012), 12/31/03; Training Course (E206844), 08/30/04 •Guidelines for Inspection and Maintenance of Line Damper Components: Report Outline. Technical Update (1002013), 10/30/03; Technical Report (1002014),10/30/04 • Strategy for the New Edition of the Reference Book. Technical Update (1002015), 11/30/03 •Draft of New Edition for Peer Review. Technical Update (1002016), 10/30/04 •New Edition "Reference Book on Wind-Induced Conductor Motion. Technical Report (1002016), 7/31/05

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Commercial

38. EPRI-Enhanced Non-Ceramic Insulator (NCI) Performance (051993)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Polymer insulators are proliferating on electricity system because of a lack of availability of porcelain insulators, ease of handling, and resistance to vandalism. Polymer insulators also have certain disadvantages and uncertainties. This project will continue to address a range of NCI concerns including selection, application, and inspection.	Can technology be applied to increase the reliability and/or availability of equipment? Can we increase the efficiency of system components?	• Adopt advanced materials that enhance the durability of system components • Employ advanced design techniques that enhance the durability of system components • Develop materials to increase efficiency of system components	• Results of 230kV Aging Test. Technical Update (1002024), 09/30/03; Report (1001746), 06/30/04 • Promising Technologies for the Inspection of Polymer Insulators: Technology Review and Evaluation. Technical Report (1002025), 12/31/03 • Development Plan for Identified Inspection Technology. Technical Update (1002026), 04/30/04 • Failure Experience with Polymer Insulators. Technical Update (1002027), 12/31/03 • Effect of High Conductor Temperatures on the Performance of Polymer Insulators. Technical Report (1002028), 03/31/04

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability, Equipment Efficiency	Key	Commercial

39. EPRI-Demonstration of 345 kV XLPE Cable System (051985)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Reduce capital cost and improve reliability by demonstrating the replacement of environmentally sensitive high-pressure fluid-filled (HPFF) cable systems with new Cross-Linked Polyethylene (XLPE) cables in existing underground pipes. The project will provide the experience of establishing correct installation procedures; and the one-year field test will provide the basis for assessing the reliability of the system under actual loading conditions.	Can technology be applied to increase the reliability and/or availability of equipment? Can we increase the efficiency of system components?	• Adopt advanced materials that enhance the durability of system components • Employ advanced design techniques that enhance the durability of system components • Reduce the cost of transmission related technologies and components	•Field experience with HPFF cable systems •The project is planned to be completed in 2005

Funding/Source	Participants	Point of Contact
large metropolitan U.S. electricity company	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability, Equipment Efficiency	Pacing	Demonstration

40. EPRI-Novel and Low Cost Techniques to Measure Temperature of Conductors, Transformers and Cables (051835)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project will improve reliability of conductors, transformers, and cables through low-cost online temperature monitoring. The availability of low-cost temperature sensors will enable the industry to move closer to the ideal of a dynamically rated system. Key requirements that must be met are low cost, reliable performance, and good aging characteristics (i.e., the sensor systems should not have to be recalibrated too often).	Can the ratings of existing equipment/components be increased? Can technology be applied to increase the reliability and/or availability of equipment? Can we increase the efficiency of system components?	• Use actual system conditions in place of worst case conditions to determine thermal and stability limits • Employ advanced design techniques that enhance the durability of system components • Reduce the cost of transmission related technologies and components	•Temperature sensor for conductors •Temperature sensor for transformers •Test beds and technical reports

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Ratings & Operating Limits, Equipment Reliability & Availability, Equipment Efficiency	Key	Development

41. EPRI-Technology Development of Energy Storage Options for Improved T&D Asset Utilization (051557)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project will perform the necessary R&D to improve the cost and performance of energy storage devices that can be used for T&D asset utilization applications. The technology options focused on will be super-capacitor, battery, flywheel, and superconducting magnetic energy storage devices. The development efforts will include improvements in design, key material properties and the control system to operate these devices properly for T&D applications	Can we increase the efficiency of system components?	• Apply storage technologies to enhance transmission capabilities	•Improved energy storage products •Technical reports

Funding/Source	Participants	Point of Contact
Cofunding from possible manufacturers and/or U.S. Department of Energy (DOE)/Department of Defense (DOD) will be required on any of the technology development efforts.	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Efficiency	Key / Pacing	Development

42. EPRI-Energy Storage to Mitigate Stability Limited Transmission Systems (051554)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project will determine preferred design(s) and cost estimate(s) for energy storage systems to provide the real power transient damping necessary to increase stability limits of the transmission systems. The storage system may be deployed independently or added to FACTS devices to increase the transmission stability limit. Special attention will be paid to storage systems that can be easily maintained.	Can we increase the efficiency of system components? Can we upgrade system elements to increase their capacity?	• Apply storage technologies to enhance transmission capabilities • Increase transfer capabilities/limits	•Overall performance (i.e., efficiency and operating cost) of the storage facility will be estimated •Economic and technology feasibility studies with host utilities will also be a part of this project

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization. Capacity Additions	Equipment Efficiency, System Upgrades	Pacing	Demonstration / Development

43. EPRI-Avian Interactions With Power Structures, Wind Turbines and Communication Towers (101940)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this project is to mitigate and reduce avian fatalities and increase power reliability. Avian interactions (i.e. collisions and electrocutions) with overhead power lines, wind turbines, communication towers, and other utility structures can disrupt service and/or adversely affect bird populations.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Reduce the impact of environmental conditions (e.g., lightning, fire, storm, salt) and terrorism	PIER and EPRI are developing and testing automated avian monitors to address the need to gather collision and electrocution information that is difficult and costly to obtain, to help standardize monitoring methods, and to evaluate the efficacy of bird deterrent devices.

Funding/Source	Participants	Point of Contact
EPRI, CEC	Electric Power Research Institute (EPRI), EDM Inc.	EPRI: Richard Carlton, (650) 855-2115 CEC: Linda Spiegel (916) 654-4703

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Demonstration

44. PSERC-Electrical Transmission Line Insulator Flashover Predictor (T-4)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Under this research project, a technique is developed to measure and analyze the "signature" of leakage current in transmission line insulators to predict the probability of a flashover and to estimate the insulator's "pollution level" (as measured by the equivalent salt deposit density). To test the technique, a leakage current monitor will be constructed with a cellular phone interface and installed on an actual transmission tower.	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance)	•Project complete

Funding/Source	Participants	Point of Contact
•Funding Period: August 1999 to July 2001 •Funding: $17,500 per year	George Karady (Arizona State – lead: karady@asu.edu); Salt River Project	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Demonstration

45. PSERC-Condition Monitoring and Maintenance Strategies for In-Service Non-Ceramic Insulators (NCI), Underground Cables and Transformers (T-6)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project focuses on assessment of the condition of nonceramic insulators for preventive maintenance planning, and development of laboratory test methods for rapid and meaningful prediction of future performance. Topics in the research include: a) Effect of electrical discharges (corona and arcing) on housing performance under humid conditions; b) Brittle fracture research on fiberglass rods for nonceramic insulators; c) Aging tests on nonceramic distribution insulators;Inspection guide for replacing nonceramic insulators.	Can technology be applied to increase the reliability and/or availability of equipment? Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Reduce outages due to equipment failure (e.g., preventive/predictive maintenance) • Increase the precision of system protection	•Project complete

Funding/Source	Participants	Point of Contact
•N/A	Ravi Gorur (Arizona State – lead: ravi.gorur@asu.edu); Salt River Project	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Commercial

46. PSERC-Redesign and New Interpretation of Power Acceptability Curves for Three Phase Loads (T-7)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The principle objective of this project is the modification of power acceptability curves to improve their accuracy with three phase loads. Curves will be analyzed considering energy disturbances and different load levels. One result of the work will be the development of a method for determining whether short and longer transient voltage sags are acceptable or unacceptable.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Increase the precision of system protection	•Project complete

Funding/Source	Participants	Point of Contact
•Funding Period: August 2000 to December 2001 •Funding: $40,000 per year	Gerald T. Heydt (Arizona State – lead: heydt@asu.edu) and Raja Ayyanar (Arizona State); Rao Thallam , John Blevins and Tom LaRose (Salt River Project)	Dennis Ray Executive Director, PSERC (608) 265 -3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Commercial

47. PSERC-Investigation of Fuel Cell Operation and Interaction within the Surrounding Network (T-8)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
In this research, technical and economic issues associated with the use of fuel cells will be investigated by studying the operation of a 200 kW gas-fired fuel cell installed in Mesa, Arizona State. Potential problems due to interaction with the local distribution network will be identified and the effects of several fuel cells operating in parallel will be assessed.	Can technology be applied to increase the reliability and/or availability of equipment? Can we increase the efficiency of system components?	• Employ advanced design techniques that enhances the durability of system components. • Apply storage technologies to enhance transmission capabilities	•Project complete

Funding/Source	Participants	Point of Contact
•Funding Period: August 2000 to December 2001 •Funding: $30,000 per year	George Karady (Arizona State – lead: karady@asuvax.eas.asu.edu); Salt River Project	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Pacing	Demonstration

48. PSERC-Voltage Collapse Margin Monitor (S-2)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
In this project, the researchers are developing a prototype software tool for systematically monitoring and assessing how close a power system is to voltage collapse considering variations in demand, power transactions and other system operating conditions.	Can we reduce the operating margins of the system? How can we improve the quality and quantity of operating information?	• Develop new operating techniques • Develop operating condition monitoring (e.g., power flow, voltage, temperature)	•Project complete

Funding/Source	Participants	Point of Contact
•Funding Period: October 1997 to December 2000 •Funding: $75,000 first two years and $40,000 for 2000	Hsiao-Dong Chiang (Cornell – lead: chiang@ee.cornell.edu), Pete Sauer (Illinois) and Ian Dobson (Wisconsin)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Ratings & Operating Limits	Key	Development

49. PSERC-Impact of Protection Systems on Reliability (S-4)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project is developing tools for computing the increase in transmission system reliability from investments in new equipment, and from changes in relaying philosophy or in operating policy. A statistical approach is used to investigate where changes in the protection system could be most effective and to evaluate the reliability improvement obtained from monitoring the protection system.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Increase the precision of system protection	•Project complete

Funding/Source	Participants	Point of Contact
•Funding Period: January 1998 to December 2000 •Funding: Year 1: $50,000. Year 2: $40,000. Year 3: $60,000	Jim Thorp (Cornell – lead: thorp@ee.cornell.edu) and Jim Bucklew (Wisconsin)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Commercial

50. PSERC-Integrated Security Analysis (S-7)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project is investigating the integration of existing tools for static, dynamic, voltage and steady-state stability security assessment into a comprehensive security analysis framework. The objective is to improve efficiency for determining security results from both off-line and on-line computations, and for effectively conveying those results to system operators. The project will exploit new concepts in intelligent systems.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism? How can we improve the quality and quantity of operating information?	• Increase the precision of system protection. • Develop advanced decision support tools (optimal power flow, real-time security assessment, dynamic scheduling)	•Project complete

Funding/Source	Participants	Point of Contact
•Funding Period: October 1999 to September 2001 •Funding: $75,000 per year for two years (2000 and 2001)	Kevin Tomsovic (Washington State University – lead: tomsovic@eecs.wsu.edu) and Pete Sauer (Illinois)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Key	Demonstration

51. PSERC-Coordination of Line Transfer Capability Ratings (S-8)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Power transfer capacity is limited by non-linear phenomena including constraints on reactive power reserves, transient stability limits and damping of inter-area oscillations. This project will develop tools for computing optimal transfer capability of strategic transmission paths under power-flow and small-signal stability constraints.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Increase the precision of system protection	•Project complete

Funding/Source	Participants	Point of Contact
•Funding Period: October 1998 to September 2001 •Funding: $38,000 per year (1998 and 1999)	Mani V. Venkatasubramanian (Washington State University – lead)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Demonstration

52. PSERC-Intelligent Substation (T-5)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
To advance the effective use of predictive maintenance, this project integrates technological advances from artificial intelligence, fault diagnostics, and data processing to provide the technical capability at substations for self-monitoring, self-diagnosis and communication of self-assessment results to a substation maintenance authority.	Can technology be applied to increase the reliability and/or availability of equipment? How can we improve the integration of power system components? What are the anticipated values/benefits of improved system operations?	• Reduce outages due to equipment failure • Develop substation automation • Develop enhanced communications architecture • Develop expert systems to carry out complex control orders	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period September 1999 to September 2003 •Funding: $50,000 per year	Rahmat A. Shoureshi (lead: rshoures@mines.edu); Tyrone Vincent, Tor Fretheim, Andy Ottele and Dan Flaherty (Colorado School of Mines); and Mladen Kezunovic (Texas A&M); John Work and Paulette Kaptain (WAPA)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization, Advanced Component Optimization	Equipment Reliability & Availability, System Operability	Base / Key	Demonstration

53. PSERC-Accurate Fault Location in Transmission and Distribution Networks Using Modeling, Simulation and Limited Field-Recorded Data (T-10)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This research is to develop algorithms for accurate fault location in transmission and distribution systems. Accurate fault location will enhance quick restoration of the system. Genetic algorithms, short circuit studies, transmission line traveling wave theory and the wavelet transform will be used to develop the algorithms.	Can we decrease the time required to restore failed components?	• Improve fault location identification to decrease restoration time	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period: September 1, 2000 to August 31, 2002 •Funding: $38,000 per year for two years (2001-2002)	Mladen Kezunovic (Texas A&M – lead: kezunov@ee.tamu.edu) and Ali Abur (Texas A&M); ABB ETI, ABB NM, Entergy Services, Mitsubishi ITA, Reliant Energy HL&P and Oncor	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Restoration	Key	Demonstration

54. PSERC-Evaluation of Critical Components of Nonceramic Insulators (NCI) In-Service: Role of Seals and Interfaces (T-14)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
A close look at the root cause of failures of NCI indicates that seals and interfaces are the origin for a vast majority of failures in service. The project goal is to study the mechanisms of degradation, establish the threshold limits of degradation, and create a ranking for resistance to corona damage of various NCI used presently by participating utilities.	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance)	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period June 1, 2002 to June 1, 2004 •Funding: $23,000 per year for two years	Ravi Gorur (Arizona State-lead: ravi.gorur@asu.edu), Bob Olsen (Washington State), SRP (Art Kroese) and WAPA (Fred Cook)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Commercial

55. PSERC-Voltage Dip Effect on Loads in Electric Power System (T-16)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The voltage dip has devastating effect of certain type of industrial loads, but has no harmful effect on household loads. This project's statistical evaluation of the dip depth and duration effect on different loads permits the estimation of system vulnerability.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Increase the precision of system protection	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period: June 1, 2002 to June 1, 2004 •Funding: $30,000 per year for two years	George G Karady (Arizona State-lead: karady @asu.edu), Rahmat Shoureshi (Colorado School of Mines); Arizona Public Service Co. (Baj Agrawal) and Western Area Power Administration (Paulette Kaptain)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Commercial

56. PSERC-Automated Integration of Condition Monitoring with an Optimized Maintenance Scheduler for Circuit Breakers and Power Transformers (T-19)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Cost-effective transmission equipment maintenance requires on-going integration of information from multiple sources. Human coordination of this information is tedious and costly. This project addresses the need to develop a real-time software solution that performs this information integration automatically.	Can technology be applied to increase the reliability and/or availability of equipment? How can we improve the integration of power system components? How can we improve the quality and quantity of operating information?	• Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance) • Integrate and streamline database and information systems • Develop advanced decision support tools	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period June 1, 2002 to June 1, 2005 •Funding: $85,000 per year for three years	Jim McCalley (Iowa State, EE-lead: jdm @iastate. edu), Mladen Kezunovic (Texas A&M, EE), Chanan Singh (Texas A&M, EE), Vasant Honavar (Iowa State, Computer Science), Mid American Energy (Andrew Geest), Omaha Public Power District (Jim Foley), Reliant Energy HL&P (Don Sevcik), TXU (Jim Bell), Mitsubishi (David Wong)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base / Key	Demonstration

57. PSERC-Fault Location Using Sparse Data and Wireless Communications for Collection of PQ Data in the TVA System (T-21)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project will be implementing new algorithms for fault location and developing a wireless communication infrastructure for collecting data from PQ meters in the TVA system.	Can we decrease the time required to restore failed components? How can we improve the integration of power system components?	• Improve fault location identification to decrease restoration time • Develop enhanced communications architecture	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period September 1, 2001 to December 31, 2002 •Funding 2001: $33,075. 2002: $37,800. This project uses targeted research funds.	Mladen Kezunovic (Texas A&M – lead: kezunov@ee.tamu.edu), Ali Abur and C. Georghiades (Texas A&M); TVA	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Restoration	Key	Demonstration

58. PSERC-Steady State Voltage Security Margin Assessment (S-11)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project focuses on the determination of the steady state voltage security margin of a given high voltage transmission grid, under specified transactions and loading conditions. Implemented procedures, with associated software, will produce security margin estimates for any selected bilateral transaction in a power system, and allocate reactive power usage to loads and transactions.	Can the ratings of existing equipment/ components be increased? Can we reduce the operating margins of the system?	• Use actual system conditions in place of worst case conditions to determine thermal and stability limits • Develop new operating techniques	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period: September 2000 to August 2002 •Funding: $38,000 per year (2000 and 2001)	Garng M. Huang (Texas A&M – lead: huang@ee.tamu.edu) and Ali Abur (Texas A&M); ABB ETI, ABB NM, Entergy Services, Mitsubishi ITA, Reliant Energy HL&P and Oncor	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Ratings & Operating Limits	Key	Demonstration

59. PSERC-Comprehensive Power System Reliability Assessment (S-13)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project uses an integrated approach to reliability assessment to address issues associated with component reliability as well as system reliability. The proposed reliability analysis methods will provide reliability indices at the customer site, and sensitivities of reliability levels to specific power market transactions. The results will enable cost benefit analyses (since design options can be easily characterized with cost) and risk assessment.	Can technology be applied to increase the reliability and/or availability of equipment? Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance) • Increase the precision of system protection	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period: January 2001 to December 2003 •Funding: $38,000 per year	A. P. Meliopoulos (Georgia Tech – lead: sakis.meliopoulos @ece. gatech.edu), David Taylor (Georgia Tech), and S. W. Kang (Georgia Tech); Mike Agee (Duke Energy)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Demonstration

60. PSERC-Detection, Prevention and Mitigation of Cascading Events (S-19)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project will investigate novel approaches using new technologies to provide effective control of cascading disturbances and to enhance reliability. When a power system is subjected to large disturbances, and the vulnerability analysis indicates that the system is approaching a potential catastrophic failure, control actions need to be taken to steer the system away from severe consequences, and to limit the extent of the disturbance.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Increase the precision of system protection	•Project ongoing We are approaching the problem in three steps: 1. Detection of major disturbances and protective relay operations leading to cascading events. 2. Wide area measurement based remedial action. 3. Adaptive islanding with selective underfrequency load shedding.

Funding/Source	Participants	Point of Contact
•Funding Period: June 1, 2002 to June 1, 2005 •Funding: $80,000 per year for three years (2002-2004).	Vijay Vittal (Iowa State University-lead: vittal@ee.iastate.edu), Mladen Kezunovic (Texas A&M) and Mani Venkatasubramanian (Washington State); Hydro Quebec, IREQ (Innocent Kamwa). MidAmerican Energy (Miodrag Djukanovic) and Entergy (Sharma Kolluri)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Key	Demonstration

61. CERTS-Grid of the Future White Papers

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
In 1999, the Department of Energy tasked CERTS to prepare a series of white papers on federal RD&D needs to maintain or enhance the reliability of the U.S. electric power system under the emerging competitive electricity market structure.	N/A	• N/A	The preparation of the white papers benefited from substantial electricity industry review and input, culminating with a DOE/CERTS workshop in the fall of 1999 where drafts of the white papers were presented by the CERTS authors, and discussed with industry stakeholders.

Funding/Source	Participants	Point of Contact
DOE Transmission Reliability Program	CERTS	Joe Eto Lawrence Berkeley National Laboratory (510) 486-7284

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	N/A	Base	Commercial

62. CERTS-U.S. Department of Energy Power Outage Study Team

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The Power Outage Study Team (POST) was a panel of DOE, national laboratory, and academic experts appointed by the Secretary of Energy to study selected power system events that took place between early June and early August 1999 and make recommendations for appropriate federal actions. CERTS provided coordination and logistical support to DOE for POST.	N/A	• N/A	POST conducted three technical workshops in late January, 2000 at which the team heard public comment on appropriate federal actions to address the POST's findings. POST presented 12 recommendations for federal actions in a Final Report, released in March, 2000.

Funding/Source	Participants	Point of Contact
DOE Transmission Reliability Program	DOE, CERTS	Joe Eto Lawrence Berkeley National Laboratory (510) 486-7284

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	N/A	Base	Commercial

63. IEEE-CERTS Conference: Ensuring Electric Power Reliability-The Challenges Ahead

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The Symposium examined the challenges that lie ahead for ensuring reliability as the U.S. electric power system undergoes the most fundamental transformation in its operation since its creation over 100 years ago. The Symposium was held to ensure that information is provided to lawmakers during the upcoming debates on reliability and the restructuring the electric power industry.	N/A	• N/A	The Symposium explored the perspectives of market participants, system operators, government, and academics on various aspect of reliability, including market operations, system management, industry oversight, and research and development.

Funding/Source	Participants	Point of Contact
DOE Transmission Reliability Program	DOE, CERTS	Joe Eto Lawrence Berkeley National Laboratory (510) 486-7284

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Commercial

64. Sandia National Labs-Energy and Critical Infrastructure Program

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Sandia recently completed an analysis of the reliability of one of the nation's utility grids (Texas) that quantifies the impact of deregulation on the reliability of the grid. Other efforts involve studies of the effects of component aging on the reliability and lifetime of nuclear power plants, and an understanding of the effects of supply disruption on the reliability of the power grid.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Reduce the impact of environmental conditions (e.g., lightning, fire, storm, salt) and terrorism.	•Improved understanding of critical infrastructure vulnerabilities •Identify specific areas in immediate need of improvement

Funding/Source	Participants	Point of Contact
DOE	DOE, ERCOT	Kathie Hiebert-Dodd klhiebe@sandia.gov

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Demonstration

65. Oak Ridge National Labs-Composite Conductor Project

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Composite conductor project. Replace steel with an advanced aluminum composite core. Offers options for increasing ampacity without increasing structural loads.	Can we increase the efficiency of system components? Do new transmission components offer significant increases in capacity?	• Develop materials to increase the efficiency of system components • Increase the capacity of transmission components (conductors, transformers, towers, insulators, underground cable, etc.)	Develop a composite conductor for overhead transmission lines. This conductor will be lighter and have a smaller coefficient of thermal expansion than steel.

Funding/Source	Participants	Point of Contact
DOE. 3M Corporation.	DOE/Oak Ridge National Lab. 3M Corporation.	John Stovall (865) 574-5198 Brendan Kirby (865) 576-1768 Tracy Anderson (3M Corp) (651) 736-1842

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization, Capacity Additions	Equipment Efficiency, New Components	Key	Development

66. Oak Ridge National Labs-Superconductor Transformer Project

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Superconductor transformer project. ORNL is contributing to the design, production and testing of a high temperature superconducting transformer.	Can we increase the efficiency of system components? Do new transmission components offer significant increases in capacity?	• Develop materials to increase the efficiency of system components • Increase the capacity of transmission components (conductors, transformers, towers, insulators, underground cable, etc.)	Design a more efficient transformer that is nonflammable, have a lower environmental impact, and be lighter and more fault-tolerant than conventional transformers.

Funding/Source	Participants	Point of Contact
DOE	DOE/Oak Ridge National Lab Waukesha Electric Company. Intermagnetics General Corporation. Rochester Gas and Electric Corporation.	John Stovall (865) 574-5198 Brendan Kirby (865) 576-1768

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization, Capacity Additions	Equipment Efficiency, New Components	Pacing	Development

67. Oak Ridge National Labs-Superconductor Cable Project

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Superconductor cable project. Designing and building a high temperature superconducting dielectric cable.	Can we increase the efficiency of system components? Do new transmission components offer significant increases in capacity?	• Develop materials to increase the efficiency of system components • Increase the capacity of transmission components (conductors, transformers, towers, insulators, underground cable, etc.)	Increase the conductor length, increase the current density with lower losses than conventional cables.

Funding/Source	Participants	Point of Contact
DOE, South Wire Company	DOE/Oak Ridge National Lab South Wire Company. Los Alamos National Lab	John Stovall (865) 574-5198 Brendan Kirby (865) 576-1768

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization, Capacity Additions	Equipment Efficiency, New Components	Pacing	Development

68. American Superconductor-Superconductor Cable Project

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
HTS power cable project. This cable could be a cost effective alternative to DC in some applications. This could be used to transfer power and fortify local transmission and distribution systems in dense urban areas.	Can we increase the efficiency of system components? Do new transmission components offer significant increases in capacity?	• Develop materials to increase the efficiency of system components • Increase the capacity of transmission components (conductors, transformers, towers, insulators, underground cable, etc.)	High capacity, low impedance and is environmentally benign due to its low EMF design.

Funding/Source	Participants	Point of Contact
American Superconductor	American Superconductor	John Howe (508) 621-4307

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization, Capacity Additions	Equipment Efficiency, New Components	Key	Demonstration

69. American Superconductor-SMES Project

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
American Superconductor's SMES is a solution to network voltage instability and other power quality problems. SMES will allow utilities and industrial customers to mitigate their exposure to voltage instability and related problems.	Can we increase the efficiency of system components?	• Apply storage technologies to enhance transmission capabilities	Eliminate low system voltages and voltage collapses. Also to reduce and eliminate voltage instability.

Funding/Source	Participants	Point of Contact
American Superconductor.	American Superconductor. National Lab	John Howe (508) 621-4307

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Efficiency	Key	Demonstration

70. Tennessee Valley Authority-Online Tension Monitoring Project

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Online Tension Monitor project. To mitigate the effects of transmission lines that run hot by using online tension monitors. Improves efficiency by 20-25%.	Can the ratings of existing equipment and components be increased? How can we improve the quality and quantity of operating information?	• Use actual system conditions in place of worst case conditions to determine thermal and stability limits • Develop operating condition monitoring (e.g., power flow, voltage, temperature)	Tennessee Valley Authority is currently evaluating the benefits of this monitoring project. It is expected to improve efficiency by 20-25%.

Funding/Source	Participants	Point of Contact
Tennessee Valley Authority	Tennessee Valley Authority	Mr. Dale Bradshaw Senior Manager (423) 751-4573

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization, Advanced System Operations	Ratings & Operating Limits, Operating Information	Key	Demonstration

71. Tennessee Valley Authority-Transformer Project

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Transformer project. Used as a dynamic thermal circuit rating tool to generate step-up power. Improves efficiency by approximately 25%.	Can we increase the efficiency of system components?	• Develop materials to increase efficiency of system components (e.g., HTS, ceramics, carbon fiber). • Develop designs/ configurations to increase efficiency of system components	This project is expected to improve efficiency by up to 25% by developing oil additives to increase power.

Funding/Source	Participants	Point of Contact
Tennessee Valley Authority	Tennessee Valley Authority	Mr. Dale Bradshaw Senior Manager (423) 751-4573

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Efficiency	Pacing	Demonstration

72. Tennessee Valley Authority-Main Improvement Line Extension (MAIN) Project

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Main Improvement Line Extension (MAIN) project. Evaluate steel pole grounding scheme by using a current transducer to measure current in micro-amps.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Reduce the impact of environmental conditions (e.g., lightning, fire, storm, salt) and terrorism	This project is expected to help mitigate some of the maintenance and outage incidents, thereby reducing the amount of dollars per outage. A patent has been developed and granted.

Funding/Source	Participants	Point of Contact
Tennessee Valley Authority This project has a budget of approximately $1million.	Tennessee Valley Authority	Mr. Dale Bradshaw Senior Manager (423) 751-4573

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Key	Demonstration

73. Tennessee Valley Authority-CVD Diamond Project

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Chemical Vapor Disposition (CVD) Diamond project. Used as a field effect transistor that improves HVDC, FACTS devices, electronic circuit breakers etc.	•Can we increase the efficiency of system components?	• Develop materials to increase efficiency of system components (e.g., HTS, ceramics, carbon fiber) • Develop designs/ configurations to increase efficiency of system components	This project is being conducted in collaboration with Vanderbilt University and it is expected to improve the efficiency of electronic circuit breakers, fax devices, HVDC and other transistor user applications.

Funding/Source	Participants	Point of Contact
Tennessee Valley Authority in partnership with Vanderbilt University.	Tennessee Valley Authority. Vanderbilt University.	Mr. Dale Bradshaw Senior Manager (423) 751-4573

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Efficiency	Pacing	Demonstration

74. California ISO-AGC Regulation by EV / Battery

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
AGC Regulation by EV: Investigate the economic and technical feasibility of using Electric Vehicles or new electrolytic storage devices to provide regulation services	Can we increase the efficiency of system components? Are current market designs inhibiting the development of new transmission facilities?	•Apply storage technologies to enhance transmission capabilities •Determine appropriate ancillary services	- Potential value in 2 years or less if the concept can be used with the new proposed electrolytic energy storage technology (help to increase the value of intermittent resources to the system). - Long term value if State and Manufacturers encourage the public to invest in Hybrid Vehicles / Electric Vehicles

Funding/Source	Participants	Point of Contact
CA ISO	CA ISO	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization; Markets	Equipment Efficiency, Market Design	Pacing	Development

75. California ISO-Reliability Initiative

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The Physical Operational Margin (POM) software is licensed to EPRI by V&R Co. It is capable of a fast contingency analysis of transmission and generator outages on a very large interconnected power system. The software can respect limits due to thermal overload, voltage level violation, and voltage instability.	Can we reduce the operating margins of the system? How can we improve the quality and quantity of operating information?	•Use actual system conditions in place of worst case conditions to determine thermal and stability limits •Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling)	Research will be performed in 2002 to extend the POM software's capability to handle transient and dynamic stability limits through representations of phase angle differences and transient energy functions.

Funding/Source	Participants	Point of Contact
CA ISO / EPRI	CA ISO / EPRI	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization, Advanced System Operations	Ratings & Operating Limits, Operating Information	Pacing	Development

76. California ISO-Dynamic Thermal Circuit Rating (DTCR)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Dynamic Thermal Circuit Rating (DTCR) : In 2002, the system will be extended to integrate the EPRI DCTR hardware and software system, including the video sagometer, to receive real-time data on the thermal rating of critical transmission lines into the Common Information Model, for suitable display.	Can the ratings of existing equipment / components be increased? How can we improve the quality and quantity of operating information?	•Develop new operating techniques •Develop operating condition monitoring (e.g., power flow, voltage, temperature)	Software

Funding/Source	Participants	Point of Contact
CA ISO / EPRI / CEC	CA ISO / EPRI / CEC	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Ratings & Operating Limits	Key	Demonstration

77. California ISO-Energy Storage Technologies

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Energy Storage Technologies: Demonstrate the system control and energy storage / provision capability of new high-tech electrolytic energy storage materials	Can we reduce operating margins of the system? Can we increase the efficiency of system components?	•Apply storage technologies to enhance transmission capabilities	Improved system control and decreased reserve requirements for intermittent resources

Funding/Source	Participants	Point of Contact
CA ISO / CEC	CA ISO / CEC	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Efficiency	Key/Pacing	Demonstration

78. BPA-Equipment Research

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Conduct research to improve the reliability of the transmission grid by increasing the reliability and performance of the individual components of the system.	Can technology be applied to increase the reliability and/or availability of equipment? Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Adopt advanced materials that enhance the durability of system components • Employ advanced design techniques that enhance the durability of system components • Design systems/system components to withstand seismic events	•Improved reliability of fiber optic cable subject to corona effects •Improved reliability of substation and transmission line equipment •Improved seismic performance of substation equipment during earthquakes •Improved performance and reliability of ACSR conductor splices

Funding/Source	Participants	Point of Contact
Total R&D Budget is $2,000,000/year Source: N/A	BPA	Jodie Wainwright Bonneville Power Administration (360) 619-6677 jlwainwright@bpa.gov

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Availability and Reliability, System Reliability & Security	Pacing	Development

79. Private Sector Superconductor Cable

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
HTS power cable project. This cable could be a cost effective alternative to DC in some applications. This could be used to transfer power and fortify local transmission and distribution systems in dense urban areas.	Can we increase the efficiency of system components? Do new transmission components offer significant increases in capacity?	• Develop materials to increase the efficiency of system components • Increase the capacity of transmission components (e.g., conductors, transformers, towers, insulators, underground cable, etc.)	High capacity, low impedance and is environmentally benign due to its low EMF design.

Funding/Source	Participants	Point of Contact
Various Cable Manufacturers	Detroit Edison, Pirelli, Sumitomo, Alcatel, South Wire, and NKT Cables	John Howe (508) 621-4307

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization, Capacity Additions	Equipment Efficiency, New Components	Key	Demonstration

80. BC Hydro-NxtPhase Optical Voltage & Current Sensors Demonstration

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project verified the performance of NxtPhase Corporation's optical sensors in a substation environment. The sensors provide high accuracy measurements of voltage and current at lower cost compared to conventional equipment, and can be used for metering, equipment protection and power quality management.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism? Can we increase the efficiency of system components?	• Increase the precision of system protection • Reduce the cost of transmission related technologies and components	•Initial field trials at Ingledow Substation are complete. •Demonstrations to evaluate the application and accuracy in power quality monitoring, and high precision metering will be pursued in future projects. •Status: Completed 2001

Funding/Source	Participants	Point of Contact
BC Hydro Strategic Research and Development Program	NxtPhase, BC Hydro	Greg Polovick (888) 964-9376

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security, Equipment Efficiency	Key	Demonstration

81. BC Hydro-Life Extension of Transformer Paper by In-Situ Restoration of Additives: Role of Dicyandiamide (DICY) in Thermally Upgraded Transformer Paper

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The objective of this project is to develop a technique to measure the residual dicyandiamide content in insulating paper and oil to assist in determining the onset of accelerated paper aging. Initial phases of this project explored the correlation between DICY and thermal stability. Testing was also done on additives restoration and treatment of the aged paper with crosslinking reagents to restore mechanical strength and thermal stability.	Can technology be applied to increase the reliability and/or availability of equipment?	• Adopt advanced materials that enhance the durability of system components • Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance)	•The first four phases of the project resulted in a number of findings. After determining further study was required, an additional fifth phase of the project was initiated to evaluate alternative detectors and additives. •Status: Active

Funding/Source	Participants	Point of Contact
BC Hydro Strategic Research and Development Program	BC Hydro	Greg Polovick and Dennis Cartlidge (888) 964-9376

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Pacing	Demonstration

82. BC Hydro-Oil Leak Detection in Submarine Cables Via Tracer Compounds

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Review and evaluate available or emerging techniques for detecting oil leaks from submarine cables including: • use of a chemical tracer • detection of specific compounds indigenous to cable oil	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/predictive maintenance)	•Phase I, a literature review and monitoring of new developments, has been completed. •Phase II of the project will first focus on a simulation of oil releases in a marine environment, evaluation of the characteristics of oil from a cable leak into the surrounding sand and water, and evaluation of the natural fluorescence of cable oil. •Status: Active

Funding/Source	Participants	Point of Contact
BC Hydro Strategic Research and Development Program	BC Hydro	Nelson Storry (888) 964-9376

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Demonstration

83. BC Hydro-Performance Evaluation of In-Service Four-Bundle Spacer Dampers

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
•Develop a field program to assess the condition of installed four-bundle spacr dampers and of the conductors under their clamps •Establish a database of the composition and aging characteristics of the elastomeric materials in use. •Perform tests to determine energy absorption and torsional stiffness of various spacer damper models and attempt to establish the remaining in-service life of four-bundle dampers.	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance)	Update BC Hydro 's database of spacer dampers Phase II will focus on the metalastic type of dampers Status: Active

Funding/Source	Participants	Point of Contact
BC Hydro Strategic Research and Development Program	BC Hydro	Jim Duxbury (888) 964-9376

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Demonstration

84. BC Hydro-Computer Assisted Diagnostics, Condition Assessment and Life Extension of Substation Equipment (Apparatus Assessment Assistant) - LABSYS

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Develop a sophisticated equipment diagnosis and condition assessment tool by expanding the capabilities of current software beyond simple data storage and retrieval from substation equipment and laboratory test results.	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/ predictive maintenance)	The software from this project, LABSYS, provides historical data and reports on demand. Officially launched at Apparatus Technical Conference 2002, LABSYS continues to generate positive feedback from users. Status: Active

Funding/Source	Participants	Point of Contact
BC Hydro Strategic Research and Development Program	BC Hydro	Alex Lam (888) 964-9376

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Commercial

85. BC Hydro-Development of Small Signal Analysis Tool (SSAT)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Loss of small signal stability in a power system may have severe impacts on secure system operation leading to widespread power outages. This co-funded project set out to meet industry needs and requirements by providing: • state of the art computational capabilities • comprehensive modeling • convenient system studies tools • user-friendly graphical interface	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Increase the precision of system protection	Status: Completed 2001 SSAT has been licensed to 21 users worldwide and has been used in the following applications: • investigation of oscillatory problems in complex systems • IPP impact studies • control system design and tuning • operation studies • research and teaching

Funding/Source	Participants	Point of Contact
Co-Funded; BC Hydro Strategic Research and Development Program	BC Hydro	Kip Morison (888) 964-9376

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Key	Commercial

86. BC Hydro-Feasibility of Microwave Radiometry for Monitoring Porcelain and Polymer Substation Equipment – Proof-of-Concept for Bushings, CTs and CVTs

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
•Determine the effectiveness of ì Wave Vision for detection of internal hot spots in porcelain and ploymer clad high voltage devices in the laboratory •Establish the relationship of hot spot detection to imminent failure •Decide if further development of a field prototype is warranted	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/predictive maintenance)	•Testing is underway •When the project is complete, a final report summarizing the findings and containing recommendations for the development of a field prototype will be issued. •Status: Active

Funding/Source	Participants	Point of Contact
BC Hydro Strategic Research and Development Program	BC Hydro	Mike Lau and Kal Abdolall (888) 964-9376

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Key	Demonstration

87. BC Hydro-Develop a Maintenance Strategy for Coating Below Ground Components of Galvanized Steel Towers

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Improve BC Hydro's maintenance strategy for below ground galvanized steel tower components by: •developing a process to assess the condition of the towers •identifying towers with potential corrosion problems •determining the optimum maintenance strategy	Can technology be applied to increase the reliability and/or availability of equipment?	• Reduce outages due to equipment failure (e.g., preventive/predictive maintenance)	•Reduced risk of structural failure •Reduced lifetime maintenance costs •Status: Active

Funding/Source	Participants	Point of Contact
BC Hydro Strategic Research and Development Program	BC Hydro	Gerhard Kehl, Terry Aben and Avaral Rao (888) 964-9376

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Base	Commercial

88. BC Hydro-Transmission Line Surge Arresters

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Reduce induced transmission line outages due to lightning strikes in the most exposed line of a common right-of-way (ROW). The project would also identify and develop other remedial measures to be applied with or without surge arresters, and explore the use of Fault Location and Reporting System (FLAR) technology as part of the solution.	Can technology be applied to increase the reliability and/or availability of equipment? Can we decrease the time required to restore failed components?	• Reduce outages due to equipment failure (e.g., preventive/predictive maintenance) • Improve fault location identification to decrease restoration time	•Simultaneous faults were found to be caused by inter-circuit ground coupling •Several types of mitigation were recommended depending on circuit voltage class •Status: Completed October 2001

Funding/Source	Participants	Point of Contact
BC Hydro Strategic Research and Development Program	BC Hydro	Jack Sawada (888) 964-9376

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	Equipment Reliability & Availability	Key	Commercial

89. Mitigation of Squirrel-Related Power Outages

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Rising costs related to damage caused to transmission infrastructure by squirrels has led numerous utilities to apply a variety of tools to prevent squirrels from approaching sensitive transmission equipment.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Reduce the impact of environmental conditions (e.g., lightning, fire, storm, salt) and terrorism	•Reduction in the frequency of outages caused by transmission damage done by squirrels •Mixed results thus far

Funding/Source	Participants	Point of Contact
N/A	Various utilities including Connecticut Power and Light, Pepco, and numerous private solution providers	**Wall Street Journal Article February 2, 2003 "Fried Squirrel Fails to Find Favor With Public Utilities" By: Barbara Carlton barbara.carton@wsj.com**

Project Area	Project Focus	Technology Characteristic	Project Type
Component Optimization	System Reliability & Security	Base	Demonstration

Appendix B: Capacity Additions Projects

The following projects have Capacity Additions as their primary focus area.

1. CEC-System Stability and Reliability: Flexible AC Transmission Systems (FACTS) Benefits Study

2. CEC-Light Activated Surge Protection Thyristor (LASPT) for Distribution System Reliability

3. CEC-EPRI Target 38A: Flexible AC Transmission System (FACTS)-Convertible Static Compensator

4. CEC-Strategic Value Analysis: GIS Development

5. CEC- Power Flow Simulations and Development of Renewable RD&D Performance Goals

6. CEC-Making California's Electricity More Affordable and Diverse: Public Power Renewable Action Team (PPREAT)

7. CEC-Making California's Electricity More Affordable and Diverse: Commonwealth Energy Corporation

8. CEC-EPRI Target 57 Rights-of-Way Environmental Issues in Siting, Development and Management

9. EPRI-FACTS Related Applications (TO-111979)

10. EPRI-US Pilot Installations of MCR-Based SVC (1007335)

11. EPRI-Demand Response Applications of Backup Generation (051862)

12. EPRI-High Voltage DC (HVDC) Overhead Transmission Line Technology (052012)

13. EPRI-Overhead Transmission Rights of Way: Surveillance, Management, and Engineering (052013)

14. EPRI-Design And Cost Estimates For Novel, Low-Cost Overhead Transmission Lines (052014)

15. EPRI-Low-Cost Emergency VAR Compensator (100459)

16. EPRI-High Surge Impedance Loading (SIL) Transmission Corridors (051854)

17. DOE-Superconductivity for Electric Systems

18. Oak Ridge National Labs-Power Electronics Project

1. CEC-System Stability and Reliability: Flexible AC Transmission Systems (FACTS) Benefits Study

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project investigated the feasibility and benefits of implementing Flexible AC Transmission System (FACTS) devices on Extra High Voltage (EHV) electricity transmission lines to increase power transfer and electricity import capabilities.	•Can we upgrade system elements to increase their capacity (e.g., voltage, conductor)?	• Increase transfer capabilities/limits	Conduct detailed technical and economical studies to investigate the benefits of Flexible AC Transmission Systems (FACTS) devices located in SDG&E's service territory. The study focus was on the potential benefits of existing and new FACTS devices in improving SDG&E's import capability.

Funding/Source	Participants	Point of Contact
CEC: $100,000 (500-97-011)	San Diego Gas and Electric (SDG&E)	**Contractor Project Manager:** Abbas Abed (619) 696-2755 **Commission** Contract Manager: Linda Davis (916) 654-3848

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Upgrades	Key	Commercial

2. CEC-Light Activated Surge Protection Thyristor (LASPT) for Distribution System Reliability

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Determine the technical and economic feasibility of replacing electronically activated surge protection thyristors currently installed on high-power T&D systems with improved custom light activated surge protection thyristors. Specifically, this Contractor will design, fabricate, and laboratory test the LASPT to determine performance characteristics.	Can we upgrade system elements to increase their capacity (e.g., voltage, conductor)?	• Increase transfer capabilities/limits	•Design, fabrication, and laboratory testing of a light activated surge protection thyristor. •Exhibit a surge response rate of 10 k (kilo) amps per microsecond (10 kA/µs) •Exhibit a peak current rate of 15 k (kilo) amps (15kA) •Exhibit minimum blocking voltage capability of 2700 volts (V).

Funding/Source	Participants	Point of Contact
CEC: $494,239 (500-98-038) Match Funding: $93,292 (ECRC)	Energy Compression Research Corporation (ECRC) was the contractor. On Oct. 6, 1999, the contract was novated to OptiSwitch Technology, Inc. (OTC). Subcontractors include Silicon Power Corporation; SRI International; and Telecom Data.	ECRC: Dr. David Giorgi (858) 452-8787, ext. 125 CEC: Jon D. Edwards (916) 654-4851

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Upgrades	Key	Demonstration / Development

3. CEC-EPRI Target 38A: Flexible AC Transmission System (FACTS)-Convertible Static Compensator

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
•The CSC is a power electronics-based controller that provides multiple compensating modes, which are needed to securely increase power transfer capability limits of existing transmission systems. •The CSC is enabling NYPA to mine 240 more MW of power from the grid precisely when they need it most—during contingency situations.	Can we upgrade system elements to increase their capacity (e.g., voltage, conductor)?	• Increase transfer capabilities/limits	•Install CSC voltage source converters for shunt and series compensation •Conduct initial field tests.

Funding/Source	Participants	Point of Contact
CEC: $62,500 (100-98-001 #1) **Match Funding:** $274,237	EPRI; Siemens Power Transmission & Distribution	**EPRI:** Aty Edris 650/855-2311 **CEC:** Don Kondoleon 916/654-3918

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Upgrades	Key	Demonstration

4. CEC-Strategic Value Analysis: GIS Development

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this contract is to supplement an existing Geographic Information System (GIS) developed and operated by the California Department of Forestry (CDF) to help identify strategic locations for using renewable energy distributed generation (DG) systems.	•What are the technical/market limitations or tradeoffs between generation and transmission?	• Develop novel configurations to reduce environmental/public impact (e.g., aesthetics/ EMF/ wetlands/ wildlife)	•Analyze existing spatial information related to energy use, environmental and demographic characteristics of sub-regions within the state; •Create required data layers on available renewable energy resources; and •Use data on problem areas within California's electricity system developed by another contract (500-00-031).

Funding/Source	Participants	Point of Contact
CEC: $280,000 (500-00-030)	California Department of Forestry	California Dept. of Forestry: Mark Rosenburg (916) 227-2658 CEC: Prab S. Sethi, P.E. (916) 654-4509

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Configurations	Base	Demonstration

5. CEC- Power Flow Simulations and Development of Renewable RD&D Performance Goals

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this contract is to investigate the extent to which renewable distributed electricity generation systems can address current and future problems facing California's electricity system while simultaneously providing other high public benefits.	•What are the technical/market limitations or tradeoffs between generation and transmission?	• Develop novel configurations to reduce environmental/public impact (e.g., aesthetics, EMF, wetlands, wildlife)	This project will help determine the necessary performance, cost characteristics, and the best locations for the renewable power technologies that will best provide the combined high electricity system and public benefits to California.

Funding/Source	Participants	Point of Contact
CEC: $730,000 (500-00-031)	McNeil Technologies and Davis Power Consultants	McNeil Technologies: Scott Haase, (303) 273-0071 CEC: Prab S. Sethi, P.E. (916) 654-4509

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Configurations	Base	Demonstration

6. CEC-Making California's Electricity More Affordable and Diverse: Public Power Renewable Action Team (PPREAT)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this project is to advance renewable energy science and technology in ways that allow PPREAT utilities, energy service providers (ESPs) and utility distribution companies (UDCs) to integrate renewable resources as a principal component of their resource portfolios.	•What are the technical/market limitations or tradeoffs between generation and transmission?	• Develop novel configurations to reduce environmental/public impact (e.g., aesthetics, EMF, wetlands, wildlife)	The PPREAT is a broad collaboration of California municipal utilities, irrigation districts, potential community aggregators (including non-utility municipalities), and renewable energy developers and others aimed at utilizing renewable resources to help ensure the cost-effectiveness, reliability and resource diversity of California's electricity system.

Funding/Source	Participants	Point of Contact
CEC: $5,854,582 (500-00-035) Match Funding: $1,272,018	Northern California Power Agency (NCPA) and Public Power Renewable Energy Action Team (PPREAT)/Center for Resource Solutions	Contractor Project Manager: John Berlin and Doug Dixon (804) 642-1025 CEC: Valentino Tiangco (916) 654-4664

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Configurations	Base	Commercial / Demonstration

7. CEC-Making California's Electricity More Affordable and Diverse: Commonwealth Energy Corporation

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this project is to develop a set of integrated renewable energy resources that will form a micro-grid capable of meeting special requirements of electricity customers in high need areas.	•What are the technical/market limitations or tradeoffs between generation and transmission?	• Develop novel configurations to reduce environmental/public impact (e.g., aesthetics, EMF, wetlands, wildlife)	Commonwealth Energy intends to develop a combination of advanced renewable energy systems using biogas and solar resources available in California's Chino Basin and will address both environmental and electricity issues.

Funding/Source	Participants	Point of Contact
CEC: $11,668,572 (500-00-036) Match Funding: $11,969,000	Commonwealth Energy Corporation and CH2M Hill, Regional Economics Research, Inc. (RER), Endecon Engineering, Renewable Energy Development Institute (REDI), Zaininger Engineering Company (ZECO), SDV/ACCI.	Commonwealth Energy Corporation: Patrick N. Lilly, (360) 906-0616 CEC: Zhiqin Zhang, (916) 654-4063

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Configurations	Base	Demonstration

8. CEC-EPRI Target 57 Rights-of-Way Environmental Issues in Siting, Development and Management

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This program develops and delivers scientific information and innovative approaches to help rights-of-way (ROW) owners/users contain costs while responding to the competitive marketplace and practicing environmental stewardship.	Can we site, permit and construct new facilities in a timely fashion?	• Develop novel configurations to reduce environmental/public impact (e.g., aesthetics, EMF, wetlands, wildlife)	This program's tools and information support rights-of-way (ROW) practices that protect the environment while controlling costs associated with ROW siting, development, and management.

Funding/Source	Participants	Point of Contact
CEC (2001): $31,690 (500-00-023) Match Funding (2001): $699,825	EPRI; EPRISolutions; Resource Strategies Inc.; URS Greiner Woodward Clyde; EDM International Inc.; Western EcoSystems Technology Inc.	EPRI: John Goodrich-Mahoney (202)293-7516 CEC: Joe O'Hagan, (916) 653-1651

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Configurations	Base	Demonstration

9. EPRI-FACTS Related Applications (TO-111979)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
FACTS applications enhance the controllability and increase the power transfer capability of transmission systems, maximizing asset utilization. In this TC, FACTS controllers are designed, developed, installed and commissioned to resolve site-specific transmission system challenges.	Can we upgrade system elements to increase their capacity (e.g., voltage, conductor)?	• Increase transfer capabilities/limits	•Design, development, installation, and testing of customized FACTS-based device for system-specific or regional transmission grid challenges

Funding/Source	Participants	Point of Contact
FACTS installations range greatly in cost and vary depending on site-specific technology requirements and application functionality	EPRI, TVA, AEP, NYPA	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Upgrades	Key	Demonstration

10. EPRI-US Pilot Installations of MCR-Based SVC (1007335)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Converting existing shunt capacitor banks into SVCs by equipping them with MCRs in systems where dynamic reactive load and voltage control are required, would effectively introduce MCRs into the US market. MCRs appear to be the most reliable and economically advantageous way of gaining the power quality and reactive power compensation benefits of controllable reactors and SVCs for US electric power systems.	Can we upgrade system elements to increase their capacity?	• Increase transfer capabilities/limits	•Gain operating experience of MCR-based SVCs •Introduce a potentially new reliability enhancing tool for US power systems

Funding/Source	Participants	Point of Contact
Funding from utility participants and EPRI matching funds	EPRI	Dr. Robert B. Schainker (650) 855-2549 rschaink@epri.com Dr. Abdel-Aty Edris (650) 855-2311 aedris@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Upgrades	Key	Demonstration

11. EPRI-Demand Response Applications of Backup Generation (051862)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Demand Response Applications of Backup Generation helps members advise customers on how to invest in/use their backup generation effectively for demand response, to preserve system reliability or earn incentives. The ability to free backup generation for pre-lights-out and/or price mitigation market engagements can avoid invoking electrical emergency plans and reduce wholesale electricity costs by millions of dollars by avoiding spot price spikes .	N/A	• N/A	•Updated BUGTEK Database Software (1002608), 11/30/03 • Interconnection Considerations for Backup Generation Applications to Demand Response Technical Report (1002609), 9/30/03

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Configurations	Base	Commercial

12. EPRI-High Voltage DC (HVDC) Overhead Transmission Line Technology (052012)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
There is a growing lack of HVDC expertise in many transmission owner organizations. This project will first review the state of the art and determine present day cost, efficiency, and reliability indices for HVDC transmission. The project work will address possible ways to improve these indices to meet today's industry needs. Prior work in this area will be reviewed and act as a starting point for these efforts.	Can we upgrade system elements to increase their capacity (e.g., voltage, conductor)?	• Increase transfer capabilities/limits	•Revised EPRI handbook on HVDC •Training course (depending on TC funding availability)

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Upgrades	Key	Commercial

13. EPRI-Overhead Transmission Rights of Way: Surveillance, Management, and Engineering (052013)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
De- and re-regulation are forcing electricity companies to look at expanded uses of their investment in rights of way. This project aims to provide engineering guidance to utilties searching for new ways to better use their investment in right of ways without adversely affecting the reliability of the overhead transmission system. Satellite surveillance for monitoring transmission and issues of animal interactions will be examined.	Can we site, permit and construct new facilities in a timely fashion? How can we improve the quality and quantity of operating information?	• Develop novel configurations to reduce environmental/public impact (e.g., aesthetics, EMF, wetlands, wildlife) • Develop operating condition monitoring (e.g., power flow, voltage, temperature)	•Technical report

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Configurations	Base	Commercial

14. EPRI-Design And Cost Estimates For Novel, Low-Cost Overhead Transmission Lines (052014)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Lower transmission capital costs and construction time by using the latest best practices for design, low cost materials, procurement, and quick construction. This project will develop a Handbook delineating best practices for such transmission line capital improvements.	Can we increase the efficiency of system components? Can we site, permit and construct new facilities in a timely fashion?	• Reduce the cost of transmission related technologies and components • Develop novel configurations to reduce environmental/public impact (e.g., aesthetics, EMF, wetlands, wildlife)	•Best practices handbook

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Configurations	Key	Commercial

15. EPRI-Low-Cost Emergency VAR Compensator (100459)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
A low-cost VAR compensator that provides emergency voltage support will enable companies to reduce capital equipment costs for mitigating voltage dips and voltage instability at the substation level. This project will develop a shunt compensator, called CAPS (CAPpacitor bank series group Shorting), that meets emergency needs for reactive power. CAPS consists of a number of series-connected capacitor banks. It mitigates voltage dips and voltage instability by temporarily shorting a portion of these banks.	Can we upgrade system elements to increase their capacity?	• Increase transfer capabilities/limits	•A shunt compensator, called CAPS (CAPpacitor bank series group Shorting) •Progress on this project critically depends on a host customer deploying this technology.

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Upgrades	Key	Demonstration

16. EPRI-High Surge Impedance Loading (SIL) Transmission Corridors (051854)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Surge Impedance Loading (SIL) of a transmission corridor is an index used to measure the power carrying capability of a transmission line, particularly for long transmission lines. SIL is a function of the transmission voltage and the surge inductive and reactive impedance of the transmission line. The project will investigate methods to increase SIL for existing lines as well as for new line designs.	Can we upgrade system elements to increase their capacity?	• Increase transfer capabilities/limits	•The techniques investigated will include improvements in conductor configurations and passive and active elements for increasing stray capacitance and reducing line inductance.

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Upgrades	Key	Commercial

17. DOE-Superconductivity for Electric Systems

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Created in 1988, the DOE Superconductivity for Electric Systems program is the leading US federal effort in High Temperature Superconductors (HTS) research involving world-class industry/ government/ university teams focused on developing and commercializing electric power applications of HTS. .	Do new transmission components offer significant increases in capacity? Can we increase the efficiency of system components?	• Increase the capacity of transmission components (e.g., conductors, transformers, towers, insulators, underground cable, etc.) • Develop materials to increase efficiency of system components (e.g., HTS, ceramics, carbon fiber).	•Advances in the development of HTS technology and components •Advances in the fabrication technology of HTS components •Insight into the practicalities of HTS operations

Funding/Source	Participants	Point of Contact
DOE (50%), industry participants	27 manufacturers (e.g,,American Superconductor, 3M and GE), 8 labs (e.g.,EPRI, Oak Ridge N.L., and Argonne N.L.), 10 utilities (e.g., SoCal Edison, AEP and LIPA), and 19 universities	James Daley Program Director 202-586-1165 James.Daley@hq.doe.gov

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions, Component Optimization	New Components, Equipment Efficiency	Pacing	Development

18. Oak Ridge National Labs-Power Electronics Project

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Power Electronics project. Design and testing of a Voltage Sag supporter. This device will support voltage sags of 30% for 30 seconds and suppress voltage harmonics and distortions.	Can we upgrade system elements to increase their capacity (e.g., voltage, conductor)?	• Increase transfer capabilities/limits	Eliminate the effect of voltage sags that causes plant outages and equipment malfunctions. Approximately 90% of problem sags will be eliminated.

Funding/Source	Participants	Point of Contact
DOE.	DOE/Oak Ridge National Lab	John Stovall (865) 574-5198 Fang Z. Peng (865) 576-7261

Project Area	Project Focus	Technology Characteristic	Project Type
Capacity Additions	System Upgrade	Key	Demonstration

Appendix C: Advanced System Operations Projects

The following projects have Advanced System Operations as their primary focus area.

1. CEC-Electric System Reliability Enhancements

2. CEC-Development of a Real-Time Monitoring Dynamic Rating System for Overhead Lines

3. CEC-Intelligent Software Agents for Control & Scheduling of Distributed Generation

4. CEC-Phasor Measurement Units

5. CEC-USAT MOD-2 Satellite Communication System

6. CEC-Substation Reliability

7. CEC-EPRI Target 40: Grid Planning & Development

8. CEC-Target 57/30 Grid Planning & Development

9. CEC-EPRI Target 56/29: Grid Operations & Management

10. EPRI-Inter-Control Center Communications Protocol (ICCP) Extensions (TO-111620)

11. EPRI-Load Model Development-On Line Measurements (1007471)

12. EPRI-On-Line Accuracy Adjustment and Condition Monitoring for Instrument Transformers (TO-111950)

13. EPRI-Operator Training System (TO-111622)

14. EPRI-Power Quality-Based Transmission Asset Optimization Tool (1007249)

15. EPRI-Switching Safety and Reliability (1007262 and 052029)

16. EPRI-Transmission Reliability Evaluation for Large Scale-Systems (TRELSS) (TO-111625)

17. EPRI-CAR-Painter (052183)

18. EPRI-Probabilistic Transmission Planning-Probabilistic Load Flow, Probabilistic SSSP, And Studies of FACTS/DC/Superconductor Grid (052183)

19. EPRI-Develop Security for Distribution Automation and SCADA Systems (056016)

20. EPRI-Smart Substations: Upgraded Existing/New Substations With State-of-Art Condition Based Monitoring and Diagnostics (052043)

21. PSERC-Market Mechanisms (M-2)

22. PSERC-Differential GPS Measurement of Overhead Conductor Sag (T-2)

23. PSERC-On-Line Peak Loading of Substation Distribution Transformers Through Accurate Temperature Prediction (T-3)

24. PSERC-Avoiding and Suppressing Oscillations (S-3)

25. PSERC-Automated Operating Procedures for Transfer Limits (S-5)

26. PSERC-Visualization of Power Systems (S-9)

27. PSERC-Enhanced State Estimation via Advanced Substation Monitoring (T-9)

28. PSERC-Power System Monitoring Using Wireless Substation and System-Wide Communications (T-11)

29. PSERC-Differential GPS Measurement of Overhead Conductor Sag: Software Implementation (T-15)

30. PSERC-Enhanced Reliability of Power System Operation Using Advanced Algorithms and IEDs for On-Line Monitoring (T-17)

31. PSERC-Smart Sensor Development for Power Transmission and Distribution (T-20)

32. PSERC-New System Control Methodologies (S-6)

33. PSERC-Power System State Estimation and Optimal Measurement Placement For Distributed Multi-Utility Operation (S-10)

34. PSERC-Robust Control of Large-Scale Power Systems (S-12)

35. PSERC-Risk-Based Maintenance Allocation and Scheduling for Bulk Transmission System Equipment (S-14)

36. PSERC-Security Enhancement through Direct Non-Disruptive Load Control (S-16)

37. PSERC-Techniques for the Evaluation of Parametric Variation in Time-Step Simulations (S-17)

38. PSERC-Visualization of Power Systems and Components (S-18)

39. Los Alamos National Labs-ElectriSims

40. CERTS-Real-Time Reliability Management Tools

41. CERTS-System Security Management Tools

42. CERTS-Advanced Measurement Technologies and Controls

43. California ISO-Load Following and Ramp Planning Tool

44. California ISO-Control to CPS1 and CPS2

45. California ISO-Improved ACE Control

46. California ISO-Short-Term Regional Generation Forecasting Tool

47. California ISO-Community Activity Room (CAR)

48. California ISO-Probabilistic Load Flow Tool

49. California ISO-OPTIMAL Technologies

50. California ISO-Evaluation of AIA-REMS Product

51. California ISO-Load Forecasting Tools / ANNSTLF

52. California ISO-Phasor Measurement System

53. California ISO-Grid Dynamics Monitoring System

54. California ISO-FRR Monitoring

55. California ISO-Frequency Tracking Across US

56. California ISO-Loop Flow Monitoring

57. California ISO-Validate Stability Nomograms

58. BPA-Advanced System Operations

59. BPA-System Studies and Modeling

60. BPA-System Control

61. Southern California Edison-USAT and OLM

1. CEC-Electric System Reliability Enhancements

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Power supply, network management and control systems are being driven to find new solutions to the traditional methods used to ensure stable power flows, frequency and voltage control. This project will provide integrated research and technology development that will help produce quicker and more flexible options for meeting the reliability, stability and ancillary service needs of California's electricity consumers.	How can we improve the integration of power system components? What are the anticipated values/benefits of improved system operations? Are current market designs inhibiting the development of new transmission facilities?	• Develop enhanced communications architecture • Integrate and streamline database and information systems • Determine appropriate ancillary services	•Identify and define priorities for publicly-funded reliability research •Complete research in real-time system mgmt. •Complete research in the area of integration of distributed resources •Complete research in the area of reliability and markets to ensure that a fair and transparent market for ancillary services serving consumers

Funding/Source	Participants	Point of Contact
CEC: $4,800,000 (1999/00); $2,400,000 (2000/01) DOE Match Funding: $2,500,000 (1999); $2,400,000 (2000); $8,000,000 (2001)	The Consortium for Electric Reliability Technology Solutions **(CERTS)**	**LBNL Project Contact:** Rich Wilson (510) 486-7391 **Commission Contract Manager:** Don Kondoleon (916) 654-3918

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations, Markets	System Operability, Market Design	Key	Demonstration

2. CEC-Development of a Real-Time Monitoring Dynamic Rating System for Overhead Lines

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this project is to develop a monitoring system that provides instantaneous information to electric grid operators about monitored transmission lines' power-carrying capacity and safety code compliance.	How can we improve the quality and quantity of operating information?	• Develop operating condition monitoring (e.g., power flow, voltage, temperature)	This project improves the safety and the reliability of California's electrical transmission and distribution infrastructure by providing a system able to monitor transmission line-to-ground clearance thereby avoiding fires and electrical shock hazard and reducing power outages caused by sagging lines.

Funding/Source	Participants	Point of Contact
CEC: $499,402 (500-98-034); EDM: $230,019; EPRI: $280,000	Engineering Data Management, Inc. (EDM), EPRI	**Contractor Project Manager:** Andrew H. Stewart (970) 204-4001 **Commission Contract Manager:** David A. Chambers (916) 653-7067

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

3. CEC-Intelligent Software Agents for Control & Scheduling of Distributed Generation

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this initial phase of this project was to develop a demonstration package of intelligent software agents for control and scheduling of distributed generation. An intelligent software agent can contain significant amounts of expertise and can be applied in systems requiring planning or learning capabilities.	How can we improve the integration of power system components?	• Develop expert systems to carry out complex control orders	AESC produced a software package of intelligent software agents virtually controlling and scheduling distributed energy resources and fully participating in all California market activities.

Funding/Source	Participants	Point of Contact
CEC: $554,010 (500-98-040) **Match Funding:** $34,347	Alternative Energy Systems Consulting, Inc., and Reticular Systems Inc.	Alternative Energy Systems Consulting: Gerald L. Gibson (619) 560-7182 **CEC:** Jamie Patterson (916) 654-4819

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Pacing	Demonstration / Development

4. CEC-Phasor Measurement Units

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project demonstrated real-time monitoring and potential of future control of the Western Systems Coordinating Council (WSCC) electric power grid using Phasor Measurement Units (PMUs), which are low-cost sensors that measure voltage, current phase angles and magnitudes that are time tagged for relative comparison between geographically distant locations in Southern California and Oregon.	Can we increase the efficiency of system components? •How can we improve the quality and quantity of operating information?	• Reduce the cost of transmission related technologies and components • Develop operating condition monitoring (e.g., power flow, voltage, temperature)	• Develop a system that facilitates real-time monitoring of regional transmission facilities. • Low-cost sensors and software were to be developed for use with a high-speed communication system that allows utilities and eventually regulators to monitor the status of regional transmission and distribution lines.

Funding/Source	Participants	Point of Contact
CEC: $150,000 (500-97-012)	Edison Technology Solutions (ETS)	**Contractor Project Manager:** Mohan Kondragunta (626) 815-0507 **Commission Contract Manager:** Linda Davis (916) 654-3848

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations, System Optimization	Operating Information, Equipment Efficiency	Key	Demonstration

5. CEC-USAT MOD-2 Satellite Communication System

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this project was to promote development of the USAT satellite communications system to deliver high-reliability communications for utility supervisory control and data acquisition (SCADA) systems under all types of weather conditions.	• What are the anticipated values/benefits of improved system operations? •How can we improve the integration of power system components?	• Develop enhanced communications architecture • Integrate and streamline database and information systems	• Deliver high-reliability satellite-fed data between SCADA systems of electrical transmission and distribution systems under all types of weather conditions. • Develop a satellite communications system capable of collecting high-speed SCADA data from any location in California.

Funding/Source	Participants	Point of Contact
CEC: $1,000,000 (500-97-012)	Edison Technology Solutions (ETS)	**Contractor Project Manager:** Bob Yinger (626) 815-0508 **Commission Contract Manager:** Linda Davis (916) 654-3848

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Key	Demonstration

6. CEC-Substation Reliability

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this project is to develop an intelligent alarm analysis and diagnostics system, the Alarm Analyzer. The system synthesizes thousands of pieces of information during an emergency. In a matter of seconds, the operator is presented with only the relevant and highest priority information on system status and a recommended course of action.	How can we improve the integration of power system components? What are the anticipated values/benefits of improved system operations? How can we improve the quality and quantity of operating information?	• Develop substation automation • Develop presentation and communication tools for operators (e.g., outage mapping, congestion profiling) • Develop advanced decision support tools	• Reduce the time required to produce an accurate diagnostic of an event from several hours or days to less than two minutes. • The voice recognition tools provided productivity increases in entering information into a computer file. • Operations and maintenance costs are reduced by improving productivity.

Funding/Source	Participants	Point of Contact
CEC: $215,000 (500-97-012)	Edison Technology Solutions (ETS)	**Contractor Project Manager**: Alonso Rodrigues (626) 302-8423 **Commission Contract Manager:** Linda Davis (916) 654-3848

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Key	Demonstration

7. CEC-EPRI Target 40: Grid Planning & Development

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this project is to increase the speed and efficiency of planning tools. To make effective decisions, power system planners need tools that allow them to rapidly obtain and process information, solve complex problems, and, in some cases, provide a sound business justification for their decisions.	•How can we improve the quality and quantity of operating information?	• Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling) • Develop tools for obtaining and presenting system information for planning purposes	•Develop and upgrade grid planning software and methods to increase the speed and efficiency of analytical capabilities and improve ease of use. •Enhance grid-planning software used for assessing transmission system reliability. •Improve grid-planning software with capabilities for cost/benefit analyses.

Funding/Source	Participants	Point of Contact
CEC: $98,077 (100-98-001 #1) **Match Funding:** 2001: $4,282,593	EPRI; Best Systems, Inc.; Decision Systems International; EDF—Electricite de France; EPRIsolutions; P Plus Corp.; Southern Company Services, Inc.; Vanessa MacLaren-Wray, dba	**EPRI:** Stephen Lee 650/855-2486 **CEC:** Don Kondoleon 916/654-3918

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Development

8. CEC-Target 57/30 Grid Planning & Development

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this project is to help grid planners have ample lead-time to prepare for the occasional bulk power transfer. EPRI's Grid Planning and Development program provides a comprehensive portfolio of technology solutions for coping with the short-, mid-, and long-term planning and design demands of a changing industry.	•How can we improve the quality and quantity of operating information?	• Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling). • Develop tools for obtaining and presenting system information for planning purposes	This target delivers planning aids and operator-training tools (software, methods, and information) that improve grid utilization, reduce operating costs, and ensure system security.

Funding/Source	Participants	Point of Contact
CEC (100-98-001 #1): $180,000 (1999); $180,000 (2000) Match Funding: $4,838,558 (1998) $2,206,917 (1999); $2,282,943 (2000)	EPRI; Canadian Electricity Assoc.; ESEERCO; Honeywell; P Plus Corporation; Power Technologies Inc; PSERC; Purdue Research Foundation; Southern Company Services; Texas Engineering Experiment Station; various universities	EPRI: Dan Sobajic (650) 855-8537 CEC: Don Kondoleon (916) 654-3918

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

9. CEC-EPRI Target 56/29: Grid Operations & Management

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The purpose of this project is to support EPRI's collaborative program in Grid Operations and Management, which is developing new tools and information to ensure that the power grid will be a gateway to efficient competition and the key to customer satisfaction	•How can we improve the quality and quantity of operating information?	• Develop operating condition monitoring • Develop presentation and communication tools for operators • Develop advanced decision support tools	EPRI's products give system operators a clear view of real-time grid conditions, and allow them to make decisions that take into account maximum use of the grid as well as reliability of the system.

Funding/Source	Participants	Point of Contact
CEC (100-98-001 #1): $190,000 (1999); $180,000 (2000) Match Funding: $4,838,558 (1998) $4,739,264 (1999); $4,951,836 (2000)	EPRI	EPRI: Dan Sobajic (650) 855-8537 CEC: Don Kondoleon (916) 654-3918

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

10. EPRI-Inter-Control Center Communications Protocol (ICCP) Extensions (TO-111620)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
ICCP enhancements, product support, and standards updates available from EPRI can lead to improved system security and performance, often accompanied by dramatic cost savings. The ICCP protocol allows real-time power system data to be exchanged between control centers, power plants, and customers.	How can we improve the integration of power system components?	• Develop enhanced communications architecture	•Interoperability testing results of ICCP products •Updated standards information •Results from future R&D in expanding ICCP capabilities

Funding/Source	Participants	Point of Contact
Pricing ranges from $25,000 to $50,000 per participant in smaller scale implementations to the low $100,000s per participant in larger scale implementations	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Key	Demonstration

11. EPRI-Load Model Development-On Line Measurements (1007471)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Load models are critical in simulation studies used to extend the utilization of transmission assets. Newly developed techniques for identifying physical load models from measurements will be used in conjunction with data from several utilities in order to produce improved load models. This project will obtain and catalog distribution level test and disturbance data from a number of utilities.	How can we improve the quality and quantity of operating information?	• Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling) • Develop tools for obtaining and presenting system information for planning purposes	•Field installation of load monitoring equipment •Project review meeting and quarterly updates •Field test results delivered through progress reports •Final project report and workshop

Funding/Source	Participants	Point of Contact
$100,000 to $200,000 per participating EPRI member with matching funds from EPRI	EPRI, and 3-5 utilities	Dr. Ram Adapa (650) 855-8988 Radapa@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

12. EPRI-On-Line Accuracy Adjustment and Condition Monitoring for Instrument Transformers (TO-111950)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Accurate information on actual energy flows taps hidden revenue by improving accounting of sales and purchases and increasing billable flows. Methods and devices will be developed and field tests will be performed to allow owners and operators to perform on-line monitoring and adjustment of instrument transformers, including high-voltage current transformers and capacitive voltage transformers.	How can we improve the quality and quantity of operating information?	• Develop operating condition monitoring (e.g., power flow, voltage, temperature)	•Field-ready methods and hardware for on-line accuracy adjustment and conditioning monitoring of instrument transformers •Technical report detailing results from field demonstrations, providing lessons learned, and offering application guidance

Funding/Source	Participants	Point of Contact
The cost of the project may vary between $200,000 and $500,000 depending on equipment availability for field measurement	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

13. EPRI-Operator Training System (TO-111622)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Advanced capabilities of EPRI's Operator Training System (OTS) ensure that power system operators have the skills needed to handle the increasing complexity of interconnected power grids. The sophisticated software and hardware of OTS provides a realistic model of power system dynamics.	N/A	• N/A	•Software, maintenance, and enhancements for the OTS •Customized delivery of a PC-based OTS with a real-time link to EMS •The Interconnected Power Systems Dynamics Tutorial •Training •Support

Funding/Source	Participants	Point of Contact
Total cost of the project is expected to be approximately $200,000	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Base	Commercial

14. EPRI-Power Quality-Based Transmission Asset Optimization Tool (1007249)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The project will develop a methodology for a power quality transmission asset optimization tool that will allow energy companies to prioritize investment in T&D assets and to determine the cost optimized solution between utility side investment and customer side improvement. The specific power quality determinants that will be used in the value based reliability model is voltage sag and the associated economic impact of voltage sags on sensitive customers.	How can we improve the quality and quantity of operating information?	• Develop advanced decision support tools • Develop tools for obtaining and presenting system information for planning purposes	•Methodology and algorithms for PQ Value based asset optimization tool •On-site technical assistance to adapt the methodology for your system and evaluate your system using specific data. •Quantitative graph comparing the costs of utility-side improvements with the cost of consumer-side improvements

Funding/Source	Participants	Point of Contact
$100,000 for each participating organization	EPRI	Ashok Sundaram (650) 855-2304 asundara@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

15. EPRI-Switching Safety and Reliability (1007262 and 052029)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project will increase reliability and safety while reducing errors by developing best practices and guidelines for substation and transmission switching. EPRI has made it possible for cooperating utilities to participate in surveys and undergo analysis. Experts in the field of human behavior and electrical operations have analyzed the gathered data. A variety of projects can be tailored for member utilities.	N/A	• N/A	•Prepare a draft report for 2002 and a final report for 2003 •Training Outlines for Switching: serve as a 'master' against which companies can benchmark their own programs •The Impact of New Technologies on Switching Safety

Funding/Source	Participants	Point of Contact
The cost of the project is dependent on the number and level of the tasks involved.	EPRI	Paul Dessureau (650) 855-2185 pdessureau@epri.com Ben Damsky (650) 855-2385 bdamsky@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Base	Commercial

16. EPRI-Transmission Reliability Evaluation for Large Scale-Systems (TRELSS) (TO-111625)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Custom applications and user support for EPRI's TRELSS will provide value-based, system-specific approaches for optimizing transmission system planning. This project provides customized software and upgrades, training, maintenance, and user support for TRELSS. TRELSS analyzes and quantifies the reliability of bulk power systems using a probalistic, value based approach.	How can we improve the quality and quantity of operating information?	• Develop advanced decision support tools • Develop tools for obtaining and presenting system information for planning purposes	•TRELSS has been in continuous development since 1989 and is now at version 4.0. •Currently, TRELSS load flow models are being improved with the addition of remote voltage regulation and enhanced switch-able shunt model.

Funding/Source	Participants	Point of Contact
Funding from EPRI and major utility participants	EPRI, Southern Company, Entergy Corporation, Pacific Gas and Electric Corporation	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Commercial

17. EPRI-CAR-Painter (052183)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Hard limits on inter-state power transactions can be visualized as walls that define the boundary of a Community Activity Room (CAR) within which inter-state wholesale power transactions can freely take place, for the current system load level. The Community Activity Room in development defines all possible combinations of net import and net export for the different areas of that community which would not run into the transmission limits.	How can we improve the quality and quantity of operating information?	• Develop presentation and communication tools for operators (e.g., outage mapping, congestion profiling)	•Software (December 2003)

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

18. EPRI-Probabilistic Transmission Planning -Probabilistic Load Flow, Probabilistic SSSP, And Studies of FACTS/DC/Superconductor Grid (052183)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Work will continue to extend the capabilities of the probabilistic load flow to forecast wholesale power transfer patterns, recognizing the uncertainty effect of regional weather on forced outages and loads. The EPRI Small Signal Stability Program (SSSP) will be enhanced in a major revision to incorporate the uncertainties of the generator and control parameters on the stability margin of the system. The Dynatran program, which models a combined generation and transmission system with Monte Carlo simulation, and the Probabilistic Load Flow program will be applied to studies of systems considering FACTS devices, DC lines, and superconductor cables.	How can we improve the quality and quantity of operating information?	• Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling) • Develop tools for obtaining and presenting system information for planning purposes	•Probabilistic Transmission Planning Tools, Technical Update (1002637), 12/31/03 •Probabilistic Load Flow Version 1.0 Software (1002638), 12/31/03

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Development

19. EPRI-Develop Security for Distribution Automation and SCADA Systems (056016)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Today, systems that use intelligent equipment and communications must incorporate security management to prevent intrusions and attacks on utility command and controls systems. Security technologies to meet the special challenges of secure DA and SCADA systems have not been fully developed. This project will provide an assessment of security exposures and recommendations for security technology applications to utility distribution automation and SCADA systems.	How can we improve the integration of power system components? Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Develop enhanced communications architecture • Reduce the impact of environmental conditions (e.g., lightning, fire, storm, salt) and terrorism	•Technical report on security technology applications for utility DA/SCADA systems. Technical Report (1002604), 12/31/03

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations, Component Optimization	System Operability, System Reliability and Security	Key	Commercial

20. EPRI-Smart Substations: Upgraded Existing/New Substations With State-of-Art Condition Based Monitoring and Diagnostics (052043)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This multi-year project focuses on evaluating the latest developments in monitoring, materials, sensors, diagnostics, communications and substation equipment to assess their implications to the design, construction, refurbishment and condition monitoring of substations. New concepts in substations and equipment design will be analyzed and developed. Reliability, cost, operation and maintenance aspects will be addressed.	What are the anticipated values/benefits of improved system operations? Can technology be applied to increase the reliability and/or availability of equipment? Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Develop substation automation • Adopt advanced materials that enhance the durability of system components • Employ advanced design techniques that enhance the durability of system components • Increase the precision of system protection	•Field Demonstration and Summary of Lessons Learned in the Smart Diagnosis Concept. Technical Report •(1002071), 11/30/03 • Smart Substation Guideline - Systematically Evaluation of Future Technologies. Technical Report (1002072), 12/31/04; Conference/ Workshop (E206882), 12/31/04

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Key	Commercial

21. PSERC-Market Mechanisms (M-2)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project focuses on market-based mechanisms for planning, scheduling and dispatching generation, transmission services and ancillary services. The project's development, customization and evaluation of market mechanisms incorporates the unique technological aspects of electric power.	How can we improve the quality and quantity of operating information? Can the system be modified to meet changing conditions?	• Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling) • Develop new operating techniques	•Project complete

Funding/Source	Participants	Point of Contact
•Funding Period: January 1998 to December 2000 •Funding 1998: $95,000. 1999: $130,000. 2000: $100,000.	Shmuel Oren (Berkeley-lead: oren@ieor.berkeley.edu), Fernando Alvarado, George Gross, Tim Mount, Richard Schuler, Robert Thomas, and Pravin Varaiya	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

22. PSERC-Differential GPS Measurement of Overhead Conductor Sag (T-2)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This research project will develop a device for measuring overhead conductor sag using a global positioning satellite. Use of this device in an on-line EMS will aid power system operators by providing additional data on system condition.	Can technology be applied to increase the reliability and/or availability of equipment? What are the anticipated values/benefits of improved system operations? How can we improve the quality and quantity of operating information?	• Employ advanced design techniques that enhances the durability of system components. • Develop enhanced communications architecture • Integrate and streamline database and information systems • Develop operating condition monitoring	•Project complete

Funding/Source	Participants	Point of Contact
•Funding Period: August 1997 to December 2001 •Funding: $40,000 per year	Jerry Heydt (Arizona State – lead: heydt@asu.edu) and Robert Olsen (Washington State); John Schilleci (Entergy) and Baj Agrawal (Arizona Public Service)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Key	Demonstration

23. PSERC-On-Line Peak Loading of Substation Distribution Transformers Through Accurate Temperature Prediction (T-3)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project's objective is to develop a production-grade software application that can be used to predict transformer top-oil and hot-spot temperature. This software will allow planners to more accurately know when an additional substation distribution transformer bay is needed.	How can we improve the quality and quantity of operating information?	• Develop tools for obtaining and presenting system information for planning purposes	•Project complete

Funding/Source	Participants	Point of Contact
•Funding Period: August 1998 to July 2001 •Funding: $36,750 per year	Dan Tylavsky (Arizona State – lead: tylavsky@asu.edu)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

24. PSERC-Avoiding and Suppressing Oscillations (S-3)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project determined the feasibility of computations to advise operators on how to avoid or suppress large scale system oscillations. It provided the basic understanding of the problem, developed approaches to solving the problem, and tested them to determine their feasibility.	How can we improve the quality and quantity of operating information?	• Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling).	•Project complete

Funding/Source	Participants	Point of Contact
•Funding Period: October 1997 to September 1999 •Funding: $60,000 for one year	Ian Dobson (Wisconsin – lead: dobson@engr.wisc.edu), Fernando Alvarado (Wisconsin), Chris DeMarco (Wisconsin), and Pete Sauer (Illinois)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Development

25. PSERC-Automated Operating Procedures for Transfer Limits (S-5)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project concerns automation of the operating procedures governing the establishment of transfer limits across major tie lines. This work integrates off-line studies with more general methods for ensuring dynamic security, thus improving on procedures that rely on predetermined intertie limits. The project focuses on the California – Oregon interties because specific operating procedures are available for study.	What are the anticipated values/benefits of improved system operations? Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	• Develop expert systems to carry out complex control orders • Increase the precision of system protection	•Project complete

Funding/Source	Participants	Point of Contact
•Funding Period: October 1998 to September 2000 •Funding: $38,000 per year	Kevin Tomsovic (Washington State – lead: tomsovic@eecs.wsu.edu) and Anjan Bose (Washington State); Bob Stuart (PG&E)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Pacing	Development

26. PSERC-Visualization of Power Systems (S-9)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project's goal is to develop innovative methods to assist players in the electricity industry to extract and visualize knowledge concerning power system capacity and constraints. Researchers will explore the use of techniques for knowledge extraction using two-dimensional displays and a three-dimensional virtual environment.	How can we improve the quality and quantity of operating information?	• Develop presentation and communication tools for operators (e.g., outage mapping, congestion profiling)	•Project complete •New power system visualization techniques and tools

Funding/Source	Participants	Point of Contact
•Funding Period: January 1, 2000 to December 31, 2001 •Funding: $80,000 per year (2000 and 2001)	Tom Overbye (Illinois – lead), Bob Thomas (Cornell), and Doug Wiegmann (Illinois); TVA, Entergy, Wisconsin Electric, ComED, and WAPA	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration / Development

27. PSERC-Enhanced State Estimation via Advanced Substation Monitoring (T-9)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project concerns innovative methods for using new types of analog and digital measurements at substations for improving state estimation. The new measurements are provided by a new generation of digital relays and other IEDs. The project will investigate a range of state estimation issues and will develop a prototype computer program that will be used to illustrate the effectiveness of the developed methods using real-life scenarios.	Can we increase the efficiency of system components? How can we improve the integration of power system components? What are the anticipated values/benefits of improved system operations?	• Develop design/configuration to increase efficiency of system components. • Develop substation automation	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period September 1, 2000 to August 31, 2002 •Funding $38,000 per year for two years (2000-2001)	Ali Abur (Texas A&M – lead: abur@ee.tamu.edu), Mladen Kezunovic (Texas A&M) and A.P. Meliopoulos (George Tech); ABB ETI, ABB NM, Entergy Services, Mitsubishi ITA, Reliant Energy HL&P and Oncor	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Base	Commercial

28. PSERC-Power System Monitoring Using Wireless Substation and System-Wide Communications (T-11)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project investigates wireless power system monitoring applications that communicate real-time data from substations. Research will be conducted on issues associated with data acquisition and collection, and algorithms for system-wide communications using mobile agents. A particular application, monitoring circuit breaker operations for maintenance decision-making, will be studied.	How can we improve the integration of power system components? What are the anticipated values/benefits of improved system operations? How can we improve the quality and quantity of operating information?	• Develop substation automation • Develop enhanced communications architecture • Develop operating condition monitoring (e.g., power flow, voltage, temperature)	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period September 1, 2000 to August 31, 2002 •Funding $38,000 per year for two years (2000-2001)	Mladen Kezunovic (Texas A&M – lead: kezunov@ee.tamu.edu), Costas Georghiades (Texas A&M) and Rahmat A. Shoureshi (Colorado School of Mines); ABB ETI, ABB NM, Entergy Services, Mitsubishi ITA, Reliant Energy HL&P and Oncor	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Key	Demonstration

29. PSERC-Differential GPS Measurement of Overhead Conductor Sag: Software Implementation (T-15)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The objective of this project is to implement in software (including a visual graphic depiction for easy use) work already completed in developing a Global Positioning Satellite based method for the measurement of overhead conductor sag and to use this device in an on-line EMS aid to operators.	How can we improve the quality and quantity of operating information? How can we improve the integration of power system components?	• Develop presentation and communication tools for operators (e.g., outage mapping, congestion profiling) • Integrate and streamline database and information systems	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period: June 1, 2002 to December 31, 2002 •Funding: the project budget for 2002 is $16,000. Of this, $11,000 is from PSERC. The remaining $5,000 is from ACEPS residual funds in place at ASU.	G.T. Heydt (Arizona State-lead: heydt@asu.edu) Richard Olsen (Washington State); John Schilleci (Entergy) and Baj Agrawal (Arizona Public Service)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

30. PSERC-Enhanced Reliability of Power System Operation Using Advanced Algorithms and IEDs for On-Line Monitoring (T-17)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Introduction of Intelligent Electronic Devices (IEDs) in power systems enables new monitoring applications. This project introduces new fault location, substation state estimation and wireless communication applications. It demonstrates their impact on enhancing the reliability of power system operation.	Can we decrease the time required to restore failed components? How can we improve the integration of power system components? What are the anticipated values/benefits of improved system operations?	• Improve fault location identification to decrease restoration time • Integrate and streamline database and information systems • Develop expert systems to carry out complex control orders	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period June 1, 2002 to June 1, 2005 •Funding: $75,000 per year for three years (2002-2004)	Mladen Kezunovic (Texas A&M-lead: kezunov@ee.tamu.edu), Ali Abur (Texas A&M), Sakis Meliopoulos (Georgia Tech) and Rahmat Shoureshi (CSM); TVA (M. Ingram), Reliant Energy HL&P (D. Sevcik), ABB (M. Subramanian), AEP (D. Krummen), Entergy (L. Priez), Mitsubishi (D. Wong), Tri-State G&T Association (A. Mander), TXU (J. Bell), WAPA (P. Kaptain)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Key	Demonstration

31. PSERC-Smart Sensor Development for Power Transmission and Distribution (T-20)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
On-line monitoring systems require an intelligent system to analyze and interpret large amounts of data into meaningful conclusions. This research integrates advances in power electronics, intelligent control and new sensory systems to automatically (and without major efforts of maintenance personnel) provide real-time health assessment of the T&D infrastructure. This study concentrates on the development of an intelligent optical sensor monitoring for on-line health assessment of HV oil based transformers and oil based breakers.	How can we improve the integration of power system components? How can we improve the quality and quantity of operating information?	• Integrate and streamline database and information systems • Develop operating condition monitoring • Develop presentation and communication tools for operators	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period June 1, 2002 to June 1, 2004 •Funding: $ 55,000 per year for two years.	Marcelo Simoes (Colorado School of Mines-lead: msimoes @ mines.edu), Rahmat Shoureshi (Colorado School of Mines) and Mladen Kezunovic (TAMU), Art Mander (Tri-State) and Paulette Kaptain (WAPA)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability, Operating Information	Key	Demonstration

32. PSERC-New System Control Methodologies (S-6)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project will examine new automatic generation control methodologies to accommodate alternative scenarios for competitive markets. This\ examination will include the separate ancillary services of scheduling and dispatch, frequency control, voltage control, loss allocation, and spinning reserve requirements. The project will identify the interaction and issues between technical requirements and economic incentives of alternative operating scenarios. Prototype control designs will be studied in a MATLAB-based dynamic test.	How can we improve the integration of power system components? What are the anticipated values/benefits of improved system operations?	• Develop enhanced communications architecture • Integrate and streamline database and information systems • Develop expert systems to carry out complex control orders	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period: October 1999 to September 2002 •Funding: $90,000 for three years (1999-2001)	Chris DeMarco (Wisconsin – lead: demarco@engr.wisc.edu), Ian Dobson (Wisconsin), M. A. Pai (Illinois) and Ian Hiskens (Illinois)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Pacing	Demonstration / Development

33. PSERC-Power System State Estimation and Optimal Measurement Placement For Distributed Multi-Utility Operation (S-10)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Industry restructuring calls for fundamental changes in how state estimation is done in power systems. This research investigates (1) optimal design of metering systems (particularly to maintain full system observability during switching actions), (2) distribution of data and computational burdens of state estimation among participating control areas, and (3) methods for estimating controller and system parameters as well as state variables.	How can we improve the integration of power system components? How can we improve the quality and quantity of operating information?	• Develop enhanced communications architecture • Integrate and streamline database and information systems • Develop operating condition monitoring (e.g., power flow, voltage, temperature).	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period: September 2000 to August 2002 •Funding: $38,000 per year (2000 and 2001)	Ali Abur (Texas A&M – lead: abur@ee.tamu.edu) and Garng M. Huang (Texas A&M); ABB ETI, ABB NM, Entergy Services, Mitsubishi ITA, Reliant Energy HL&P and Oncor	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability, Operating Information	Key	Demonstration

34. PSERC-Robust Control of Large-Scale Power Systems (S-12)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This research extends existing methods for robust stability analysis to deal with large-scale power system problems resulting in part from the restructuring of the electric power industry to achieve competitive market-based decision-making. It will apply modern robust control methods to develop computationally tractable algorithms suitable for large-scale problems.	How can we improve the integration of power system components? What are the practical limitations of transmission system size and scope? What are the anticipated values/benefits of improved system operations?	• Develop enhanced communications architecture • Integrate and streamline database and information systems • Develop expert systems to carry out complex control orders	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period: September 1, 2000 to August 31, 2002 •Funding: $70,000 per year for two years (2000 and 2001)	Vijay Vittal (Iowa State Univ. – lead: vittal@ee.iastate.edu), Mustafa Khammash (Iowa State Univ.), Chris DeMarco (Univ. of Wisconsin), and Peter Young (Colorado State Univ.); Innocent Kamwa (IREQ) and Dale Stevens (MidAmerican)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Key	Demonstration

35. PSERC-Risk-Based Maintenance Allocation and Scheduling for Bulk Transmission System Equipment (S-14)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The objective of this project is to develop a method of allocating economic resources and scheduling maintenance activities among bulk transmission system equipment (e.g., lines, transformers, generators, and protection systems) as a function of system risk associated with network security problems such as overloads, low voltages, cascading overloads, and voltage instability.	How can we improve the quality and quantity of operating information?	• Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling) • Develop tools for obtaining and presenting system information for planning purposes	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period: July 2001 to August 2003 •Funding: $70,000 per year for the two years	Jim McCalley (Iowa State - lead: jdm@iastate.edu), Tim Van Voorhis (Iowa State University) and A. P. Meliopoulos (Georgia Tech); Ali Chowdury (Mid-American Energy)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

36. PSERC-Security Enhancement through Direct Non-Disruptive Load Control (S-16)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Incorporating direct load control at times when the system is vulnerable can significantly enhance system security. Modern technology facilitates direct load control schemes in which customer loads having special characteristics can be effectively controlled with minimum disruption to the customer. This project examines the benefits, methods of analysis, and potential control structures that can be used.	Can technology be applied to increase the reliability and/or availability of equipment? What are the anticipated values/benefits of improved system operations?	• Employ advanced design techniques that enhances the durability of system components • Develop expert systems to carry out complex control orders	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period: June 1, 2002 to June 1, 2005 •Funding: $65,000 per year for three years	Ian Hiskens (Illinois-lead: hiskens@ece.uiuc.edu), Vijay Vittal (Iowa State); Entergy (Sharma Kolluri), GE Power Systems (Nick Miller) and IREQ Hydro Quebec (Innocent Kamwa)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Key	Demonstration

37. PSERC-Techniques for the Evaluation of Parametric Variation in Time-Step Simulations (S-17)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The results of time-step simulations are used to make crucial decisions in planning and operation; however the models used in such simulations contain many parameters that are poorly known or may take on a range of values. Tools are required to efficiently relate uncertainty bounds or probability distributions on parameter values to variations in critical outcomes of time-step simulations.	How can we improve the quality and quantity of operating information?	• Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling). • Develop tools for obtaining and presenting system information for planning purposes	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period: June 1, 2002 to June 1, 2005 •Funding: $60,000 per year for three years.	Bernard C. Lesieutre (Cornell-lead: bcl25@cornell.edu, 607-255-6501) Christopher DeMarco (Wisconsin); IREQ (Luc Audette, Alain Valette)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

38. PSERC-Visualization of Power Systems and Components (S-18)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Electric power systems are characterized by an overwhelming amount of data. The goal of this project is the continued development of better visualization techniques to help glean useable information from this data.	How can we improve the quality and quantity of operating information?	• Develop presentation and communication tools for operators (e.g., outage mapping, congestion profiling).	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period: June 1, 2002 to June 1, 2005 •Funding: $70,000 per year for three years (2002-2004).	Tom Overbye (Illinois-lead: overbye@ece.uiuc.edu), Doug Wiegmann (Illinois) and Sakis Meliopoulos (Georgia Tech); TVA (Keith Morris and Warren Wu), Exelon (Dan Sleezer and David Schooley), ATC (Paul Walter and Don Morrow), WAPA (Paulette Kaptain), PowerWorld (Ray Klump and Jamie Weber)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Development	Demonstration

39. Los Alamos National Labs-ElectriSims

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The ElectriSims model will dynamically integrate market features together with the physics of electricity flow and engineering of system components. All of this will be performed on the high performance computing machines developed under the federal Stockpile Stewardship Program.	How can we improve the quality and quantity of operating information? Are current market designs inhibiting the development of new transmission facilities?	• Develop advanced decision support tools • Develop tools for obtaining and presenting system information for planning purposes • Develop modeling tools to test and simulate markets	•Advanced modeling and simulation tool for analysis of electricity engineering, economic, and security issues

Funding/Source	Participants	Point of Contact
DOE	DOE, EPRI, University of Texas-Austin, California ISO	Charryl Berger (505) 667-3621 cberger@lanl.gov

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations, Markets	Operating Information, Market Design	Pacing	Development

40. CERTS-Real-Time Reliability Management Tools

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Key activities include development and demonstrations of prototypes for: 1) new near-real-time reliability adequacy tools for operators, 2) real-time monitoring, performance tracking for system area control error, and area interchange errors for security coordination, and 3) wide-area information visualization systems for monitoring the grid accurately, identifying root causes of problems, and taking swift action to remedy abnormal situations.	How can we improve the quality and quantity of operating information? Can we decrease the time required to restore failed components?	• Develop operating condition monitoring • Develop presentation and communication tools for operators • Improve fault location identification to decrease restoration time	•Area Control Error and Area Interchange Error: Compliance monitoring tools that pin-point sources of frequency and power interchange deviations. •VAR Management.: Demo. of geographical wide-area monitoring and of voltages and reserves at key stations. •Ancillary Services: Tracking, monitoring, and prediction for provision of ancillary services at a system level and by individual generator suppliers.

Funding/Source	Participants	Point of Contact
DOE Transmission Reliability Program; California Energy Commission	CERTS, NERC, California ISO, Electric Power Group	Carlos Martinez Electric Power Group (626) 685-2015

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Development/ Demonstration

41. CERTS-System Security Management Tools

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Key activities include research, development, and demonstration of 1) integrated security analysis infrastructures responsive to the changing conditions and increased rate and number of transactions that are part of a competitive market; 2) alternate methods to address the impact of unanticipated flows and predict their impacts on system security and reliability; and 3) real-time security control for the future.	How can we improve the integration of power system components? •What are the anticipated values/benefits of improved system operations? •How can we improve the quality and quantity of operating information?	• Develop enhanced communications architecture • Integrate and streamline database and information systems • Develop advanced decision support tools • Develop tools for obtaining and presenting system information for planning purposes	RD&D of alternative frameworks for system security management, which consists of numerous software tools that predict system conditions in response to proposed contingencies, to integrate these tools into a comprehensive package that can respond effectively to changing conditions, simultaneous transactions, and new reliability models.

Funding/Source	Participants	Point of Contact
DOE Transmission Reliability Program; California Energy Commission	CERTS, PSERC	Pete Sauer University of Illinois, Urbana-Champaign/PSERC (217) 333-0394

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability, Operating Information	Key	Development/ Demonstration

42. CERTS-Advanced Measurement Technologies and Controls

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Research, development, and demonstration of advanced measurements and controls, leading to demonstration of advanced monitoring workstations based on synchronized phasors, for new processes to improve current stability nomograms and remedial action schemes, and for advanced detection and automatic responses ensuring the reliability of the power grid.	How can we improve the quality and quantity of operating information? What are the anticipated values/benefits of improved system operations? Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	•Develop operating condition monitoring •Develop advanced decision support tools •Develop expert systems to carry out complex control orders •Increase the precision of system protection	A suite of tools, with the first set being used for synchronized phasor measurement data for post-disturbance analysis and model validation. This tool is being demonstrated in Summer 2001 by California ISO operating engineers.

Funding/Source	Participants	Point of Contact
DOE Transmission Reliability Program; California Energy Commission	CERTS, Pacific Northwest National Lab	Jeff Dagle Pacific Northwest National Lab (509) 375-3629

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations, System Optimization	Operating Information, System Operability, Reliability and Security	Pacing	Development/ Demonstration

43. California ISO-Load Following and Ramp Planning Tool

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The ISO is developing a 90 minute look-ahead tool for the Generation Dispatchers to estimate the ADS (Automated Dispatching System) dispatches of Supplemental Energy for each 10 minute period. This tool will use unit response data from other internal ISO software systems.	How can we improve the quality and quantity of operating information?	Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling)	Optimum dispatch of Supplemental Energy for Load Following and reduction in the amount of Regulation needed.

Funding/Source	Participants	Point of Contact
CA ISO	CA ISO	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

44. California ISO-Control to CPS1 and CPS2

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Develop a tool to control the system to the NERC CPS1 and CPS2 criteria rather than the existing A1 and A2 criteria. This tool will reduce the cost to system users by reducing RMS penalties associated with CPS1 and CPS2 violations.	What are the anticipated values/benefits of improved system operations?	Develop expert systems to carry out complex control orders	Improved EMS control to meet CPS1 & 2 NERC criteria with less jerking around of the System

Funding/Source	Participants	Point of Contact
CA ISO / EPRI	CA ISO / EPRI	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Key	Development

45. California ISO-Improved ACE Control

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Develop a new mathematical formula to quantitatively measure the ability of a Control Area to control ACE.	How can we improve the quality and quantity of operating information?	Develop presentation and communication tools for operators	Improvement in Control Area performance as measured by Area Control Error or ACE

Funding/Source	Participants	Point of Contact
CA ISO	CA ISO	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

46. California ISO-Short-Term Regional Generation Forecasting Tool

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project is to build a short-term regional generation forecasting tool for Supplemental Energy/Real Time Dispatch purposes. The main idea is to base forecasts on the existing weather related information that is being used for load forecasting purposes. Working on this tool with EPRI will provide tools for the CAISO's Dispatchers and the Ramp Planners.	How can we improve the quality and quantity of operating information?	- Develop advanced decision support tools (optimal power flow, real-time security assessment, dynamic scheduling)	- Implementation of FERC approved tariff for Intermittent Resources. - Increased development of Wind Generation due to removal of barriers to market participation. - Improved system operation and market efficiency

Funding/Source	Participants	Point of Contact
CA ISO / EPRI	CA ISO / EPRI	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

47. California ISO-Community Activity Room (CAR)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Transfer Limits Applications of Community Activity Room to California ISO: The main objective of this study is to inform the operators about potential thermal overloads and potential voltage limit violations that could result from a number of reasonably possible transfer scenarios, so that proper monitoring and remedial actions may be taken, under the existing operating guidelines.	How can we improve the quality and quantity of operating information?	Develop presentation and communication tools for operators (e.g., outage mapping, congestion profiling)	The results of this research will be the development of a new technology called the Community Activity Room (CAR) for visualizing the effect of transmission limits on an interconnection's wholesale power transactions.

Funding/Source	Participants	Point of Contact
CA ISO / EPRI / CEC	CA ISO / EPRI / CEC	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

48. California ISO-Probabilistic Load Flow Tool

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Application of Probabilistic Load Flow to California's Transmission Constraints: Work will continue to extend the capabilities of the probabilistic load flow to forecast wholesale power transfer patterns, recognizing the uncertainty effect of regional weather on forced outages and loads.	How can we improve the quality and quantity of operating information?	•Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling)	Enable transmission planners / operators to fully and efficiently consider the effect of increasing uncertainties on transmission requirements in the future, resulting in a more robust transmission system for reliable and competitive electricity supply.

Funding/Source	Participants	Point of Contact
CA ISO / EPRI / CEC	CA ISO / EPRI / CEC	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

49. California ISO-OPTIMAL Technologies

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Evaluation of OPTIMAL Technologies planning tools	How can we improve the quality and quantity of operating information?	•Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling)	Software

Funding/Source	Participants	Point of Contact
CA ISO	CA ISO	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

50. California ISO-Evaluation of AIA-REMS Product

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Evaluation of AIA-REMS Product: Investigate the feasibility of linking a terminal to PG&E's site where they are using this product.	What are the anticipated values/benefits of improved system operations?	•Integrate and streamline database and information systems	Waiting on Funding

Funding/Source	Participants	Point of Contact
CA ISO	CA ISO	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Key	Demonstration

51. California ISO-Load Forecasting Tools / ANNSTLF

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Intelligent Short-Term Load Forecaster: ANNSTLF (Artificial Neural Network Short-Term Load Forecaster). Improvements include a Windows-based user interface, automated tools for data handling and validation, improved holiday forecasting, and performance enhancements.	What are the anticipated values/benefits of improved system operations?	Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling)	Improved accuracy and reliability in load forecasting will enable the ISO to make optimal use of generation and power transactions resulting in potential annual savings of millions of dollars.

Funding/Source	Participants	Point of Contact
CA ISO / CERTS	CA ISO / CERTS	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

52. California ISO-Phasor Measurement System

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The Phasor Measurement System should improve monitoring of power systems for early detection and recording of very short-duration disturbances.	How can we improve the quality and quantity of operating information? Can we make the system less vulnerable to environmental conditions and terrorism/vandalism?	Develop operating condition monitoring (e.g., power flow, voltage, temperature) Increase the precision of system protection	The purpose of this project is to detect system dynamic disturbances and prevent propagation of instabilities, which in the past led to wide-spread system outages and ultimately regional blackouts.

Funding/Source	Participants	Point of Contact
CA ISO / CERTS	CA ISO / CERTS	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations, Component Optimization	Operating Information, System Reliability and Security	Key	Demonstration

53. California ISO-Grid Dynamics Monitoring System

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Grid Dynamics Monitoring System / PSYMETRIX System: Install and test the PSYMETRIX monitor and software to measure the real-time damping of the transmission system.	Can we make the system less vulnerable to environmental conditions and terrorism/vandalism? How can we improve the quality and quantity of operating information?	•Increase the precision of system protection •Develop operating condition monitoring (e.g., power flow, voltage, temperature)	The purpose of this project is to detect system dynamic operating problems and to provide warning to the system operator so that system adjustments can be made in time to prevent wide-spread system outages and/or regional blackouts.

Funding/Source	Participants	Point of Contact
CA ISO	CA ISO	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations, Component Optimization	Operating Information, System Reliability and Security	Key	Demonstration

54. California ISO-FRR Monitoring

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
FRR Monitoring and Performance Improvement: -Monitor FRR response -Evaluate tools and data for improving FRR performance	How can we improve the quality and quantity of operating information?	• Develop operating condition monitoring • Develop advanced decision support tools	Improved FRR response to system disturbances

Funding/Source	Participants	Point of Contact
CA ISO / CERTS	CA ISO / CERTS	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

55. California ISO-Frequency Tracking Across US

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Frequency Tracking Across US: Develop tool that shows the ACE and frequency across the US via web browser	What are the anticipated values/benefits of improved system operations? How can we improve the quality and quantity of operating information?	•Develop enhanced communications architecture •Integrate and streamline database and information systems •Develop operating condition monitoring	Improved system reliability by allowing Security Coordinators to have access to ACE and system frequency for control areas throughout the US

Funding/Source	Participants	Point of Contact
CA ISO / CERTS	CA ISO / CERTS	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Key	Demonstration

56. California ISO-Loop Flow Monitoring

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Loop Flow Monitoring System: Prototype system to support loop flow monitoring, management, near real-time prediction and assessment.	What are the anticipated values/benefits of improved system operations? How can we improve the quality and quantity of operating information?	•Develop enhanced communications architecture •Develop operating condition monitoring	Improved system reliability by allowing Security Coordinators to have loop flow monitoring, management, near real-time prediction and assessment tools.

Funding/Source	Participants	Point of Contact
CA ISO / CERTS	CA ISO / CERTS	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Key	Demonstration

57. California ISO-Validate Stability Nomograms

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Validate Stability Nomograms: Demonstrate use of Phasor Measurement Unit (PMU) data to validate existing stability nomograms and remedial action schemes.	How can we improve the quality and quantity of operating information?	•Develop advanced decision support tools (e.g., optimal power flow, real-time security assessment, dynamic scheduling)	Improved system reliability by allowing Operations Engineers the ability to validate existing stability nomograms and remedial action schemes.

Funding/Source	Participants	Point of Contact
CA ISO / CERTS	CA ISO / CERTS	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

58. BPA-Advanced System Operations

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Conduct research to improve the reliability of the transmission grid by increasing the visibility and operability of the transmission grid.	How can we improve the integration of power system components?	• Develop substation automation • Develop enhanced communications architecture	•Improve the visibility and operability of the system via improved substation automation

Funding/Source	Participants	Point of Contact
Total R&D Budget is $2,000,000/year Source: N/A	BPA	Jodie Wainwright Bonneville Power Administration (360) 619-6677 jlwainwright@bpa.gov

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Key	Demonstration

59. BPA-System Studies and Modeling

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Conduct research to improve the modeling of the transmission grid. Features include: •Load Modeling •Hydro Governor Modeling •Thermal Unit Governor / Load Limiter Modeling •Voltage Control •Extraction of System Models from Real-Time Data •Power Flow Software Upgrades	How can we improve the quality and quantity of operating information?	• Develop presentation and communication tools for operators • Develop advanced decision support tools • Develop tools for obtaining and presenting system information for planning purposes	Improve system model simulation results so that the modeled performance more closely matches that of the real system

Funding/Source	Participants	Point of Contact
Total R&D Budget is $2,000,000/year Source: N/A	BPA	Jodie Wainwright Bonneville Power Administration (360) 619-6677 jlwainwright@bpa.gov

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	Operating Information	Key	Demonstration

60. BPA-System Control

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Conduct research to improve the control of the transmission grid through application of Wide Area Measurement Systems (WAMS) and Wide Area Control Systems (WACS).	What are the anticipated values/benefits of improved system operations? How can we improve the quality and quantity of operating information?	•Develop enhanced communications architecture •Develop operating condition monitoring (e.g., power flow, voltage, temperature)	Improve system operation and control by providing the operators better information regarding the actual operating state of the WECC-wide grid.

Funding/Source	Participants	Point of Contact
Total R&D Budget is $2,000,000/year Source: N/A	BPA	Jodie Wainwright Bonneville Power Administration (360) 619-6677 jlwainwright@bpa.gov

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability, Operating Information	Key	Demonstration

61. Southern California Edison-USAT and OLM

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
SCE has developed a 9" flat array ultra-small antenna terminal (USAT) that allowed its network to be expanded for several applications; such as, capacitor controls, dynamic line ratings, distribution automation, interruptible load control and spinning reserve. In addition to the USAT antenna, the "Online Monitoring" interface software was also developed and tested for large packet sizes for both the USAT and OLM applications.	• What are the anticipated values/benefits of improved system operations? •How can we improve the integration of power system components?	• Develop enhanced communications architecture • Integrate and streamline database and information systems	This capability has shown improvements in system reliability. The USAT and "Online Monitoring" interface software together should prove very useful in system operations and increase system efficiency, reliability and safety.

Funding/Source	Participants	Point of Contact
Southern California Edison	Southern California Edison	**Dr. Syed Ahmed** **(626) 302-8675** **Syed.ahmed@sce.com**

Project Area	Project Focus	Technology Characteristic	Project Type
Advanced System Operations	System Operability	Key	Demonstration

Appendix D: Markets Projects

The following projects have Markets as their primary focus area.

1. CEC-California Wind Energy Consortium

2. EPRI-Enhancing Product Mix Software Capabilities (TO-111539)

3. EPRI-Measuring Demand Response to Market Prices (1000833)

4. EPRI-Power Market Simulator for Wholesale Energy Markets (051856)

5. EPRI-Operator Training Simulator and Short Term Electricity Market Simulation (052164)

6. EPRI-Long-Term Power Market Simulator (056156)

7. EPRI-Overcoming Capacity Constraints (051858)

8. PSERC-Costing and Pricing of Ancillary Services (M-1)

9. PSERC-Market Interactions and Market Power (M-3)

10. PSERC-Market Redesign: Incorporating The Lessons Learned From Actual Experiences For Enhancing Market Design (M-4)

11. PSERC-Design and Development of Bidding Agents for Electric Supply Auctions (M-5)

12. PSERC-Modeling Market Signals for Transmission Adequacy Issues: Valuation of Transmission Facilities and Load Participation Contracts in Restructured Electric Power Systems (M-6)

13. PSERC-Structuring Electricity Markets for Demand Responsiveness: Experiments on Efficiency and Operational Consequences (M-7)

14. CERTS-Market Mechanisms for Reliability Management

15. Oak Ridge National Labs-Ancillary Services Project

16. California ISO-Short-Term Electricity Market Simulator

17. BC Hydro-Develop Transmission Pricing Methods Sensitive to Reliability

1. CEC-California Wind Energy Consortium

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The PIER program has determined a need to establish the a focal center at the state level to allow coordination of diverse parties to further develop, enhance and address the needs of the wind industry in California. The purpose of this project is to provide the initial impetus for establishing the forum or consortium of parties and the recognition that is needed at the state level.	Are current market designs inhibiting the development of new transmission facilities? Can we increase the efficiency of system components?	• Determine appropriate ancillary services • Apply storage technologies to enhance transmission capabilities	•The California Wind Energy Consortium as a forum for a coordinated approach to developing wind energy systems beneficial to California's unique needs. •Investigative white papers that offer plausible approaches to optimizing wind plant facilities including transmission infrastructure issues.

Funding/Source	Participants	Point of Contact
CEC: $330,000 (500-00-029)	University of California, Davis	UC Davis: C.P. van Dam (530) 752-7741 CEC: Elaine Sison-Lebrilla (916) 653-0363

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Market Design	Base	Commercial

2. EPRI-Enhancing Product Mix Software Capabilities (TO-111539)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
EPRI offers services in the following areas with software to reduce uncertainty about market reaction to new price offerings: •Customer choice •How customers respond •Competitor response •What matters in profitability analysis •New products	Are current market designs inhibiting the development of new transmission facilities? Can the transmission system provide a broader range of products or services?	• Determine appropriate ancillary services • Determine how to make money on transmission	•Increased confidence of success when developing and introducing new products and services

Funding/Source	Participants	Point of Contact
A typical project is expected to cost $80,000	EPRI, energy services companies developing competitive retail pricing products	Ahmad Faruqui 650-855-2096 afaruqui@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Market Design, Business Models	Key	Commercial

3. EPRI-Measuring Demand Response to Market Prices (1000833)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
EPRI offers customized research projects to help utilities gain knowledge of customer demand response profiles to improve retail pricing, resource procurement, resource planning, and system operations. EPRI will customize the project to meet individual utility needs.	Are current market designs inhibiting the development of new transmission facilities? Are current transmission business models compatible with future markets and regulation?	• Develop modeling tools to test and simulate markets • Determine how to make money on transmission	•Improved insight into utility customer sensitivities •Tool to help utilities pricing plans to maximize potential returns

Funding/Source	Participants	Point of Contact
The cost of the project is $100,000	EPRI	Ahmad Faruqui 650-855-2096 afaruqui@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Market Design, Business Models	Key	Commercial

4. EPRI-Power Market Simulator for Wholesale Energy Markets (051856)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The Power Market Simulation Software, now under development, will be used to simulate hedging strategies in electricity markets before they are put into practice. It will account for market contingencies in market operations and production.	Are current market designs inhibiting the development of new transmission facilities?	• Develop modeling tools to test and simulate markets • Develop effective hedging instruments	•Beta software (December 2002) •Production software (December 2003) •Manual (December 2003)

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Market Design	Pacing	Development

5. EPRI-Operator Training Simulator and Short Term Electricity Market Simulation (052164)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The EPRI Operator Training Simulator (OTS) is being used by many utilities to assist in training its operators on the EMS functions. The Short Term Electricity Market Simulation (STEMS) developed by EPRI and being implemented for the CA ISO will be integrated with the OTS, along with the EPRI Dynamics program, which is used to provide a unit commitment program as the basis for simulating the forward electricity market . As an integrated grid and market simulator, the system will enable in-depth studies of market behavior, gaming, and related issues.	Are current market designs inhibiting the development of new transmission facilities? What are the anticipated values/benefits of improved system operations?	• Develop modeling tools to test and simulate markets • Integrate and streamline database and information systems	•Integrated Grid and Market Simulator Software (1002267-Due 12/31/03)

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Market Design	Key	Development

6. EPRI-Long-Term Power Market Simulator (056156)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The Long-Term Power Market Simulator will be developed into a robust, easy-to-use software model that will allow planners to study different scenarios of load growth, economic assumptions related to fuel prices, interest rate, required return on investment, and the effect of conservation and demand elasticity. Different market rules will also be modeled. The simulator will enable planners to evaluate the adequacy of future generation to meet future loads under a competitive power market where new power plants are built purely based on profit incentives.	Are current market designs inhibiting the development of new transmission facilities? How can we improve the quality and quantity of operating information?	• Develop modeling tools to test and simulate markets • Develop advanced decision support tools (optimal power flow, real-time security assessment, dynamic scheduling)	•Software

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Market Design	Key	Development

7. EPRI-Overcoming Capacity Constraints (051858)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project offers specific information, tools, and methods to pursue targeted demand reductions that alleviate capacity constraints through the load management and/or pricing components of demand response. Participants will obtain tools for developing their own innovative targeted programs, forecasting technical potential and customer acceptance, identifying the most appropriate technologies for each situation, performing equitable load relief settlements, and evaluating program results.	Can the transmission system provide a broader range of products or services? Are current transmission business models compatible with future markets and regulation?	• Determine how to make money on transmission	•• Updated Load Management Database (LMDB). Software (1002605), 9/30/03 •Demand Response Toolkit: Tutorial/Training Materials. Technical Update (1002606) 12/31/03

Funding/Source	Participants	Point of Contact
N/A	EPRI	EPRI Customer Assistance Center (800) 313-3774 askepri@epri.com

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Business Models	Key	Commercial

8. PSERC-Costing and Pricing of Ancillary Services (M-1)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project investigated methods for establishing justifiable costs for ancillary services. The work focused on the issues of costing reactive power and voltage control. It addressed questions of what it costs to maintain voltage; what it costs an energy provider to use an exciter; what operating costs can be allocated to voltage control; and how these services might affect a third party.	Are current market designs inhibiting the development of new transmission facilities?	• Determine appropriate ancillary services	•Project complete

Funding/Source	Participants	Point of Contact
•Funding Period: October 1997 to May 2000 •Funding: $115,000 for two years plus $25,000 NSF to Howard	Pete Sauer (Illinois - lead), Tom Overbye (Illinois), George Gross (Illinois), Fernando Alvarado (Wisconsin), Shmuel Oren (Berkeley) and James Momoh (Howard), TVA, Entergy, Wisconsin Electric, ComEd and WAPA	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Market Design	Key	Commercial

9. PSERC-Market Interactions and Market Power (M-3)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Given the move toward competitive power markets, this project is examining the incentives under market-based decision-making for market participants to invest in the careful design, operation and maintenance of the overall power system. Market designs will be proposed for ensuring power system enhancement under a wide range of operating condition and market forecast uncertainties.	Are current market designs inhibiting the development of new transmission facilities?	• Develop mechanisms to value and assign capacity rights • Determine appropriate ancillary services	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period: September 2000 to August 2002 •Funding: $70,000 per year for 2000 and 2001	Gerry B. Sheblé (Iowa State University – lead: gsheble@iastate.edu), Daniel Berleant (ISU) and Robert J. Thomas (Cornell); Dale Stevens (MidAmerican)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Market Design	Key	Demonstration

10. PSERC-Market Redesign: Incorporating The Lessons Learned From Actual Experiences For Enhancing Market Design (M-4)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
This project's objectives are to assess the interactions between the operational and commercial aspects of electricity markets; to study the impacts of the institutional market design on the experiences to date; to identify the key requirements in the reform of the market structure and specification of the appropriate rules of the road; and to propose a set of modifications to improve market design so as to fully harness the benefits of competition in electricity.	Are current market designs inhibiting the development of new transmission facilities? What information and tools are needed to improve market performance?	• Develop mechanisms to value and assign capacity rights • Develop systems to ensure transaction compliance • Develop rules and systems for congestion management	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period: July 2001 to August 2004 •Funding - 2001/2004: $50,000; 2002/2003: $100,000	Shmuel Oren (Berkeley – lead: oren@ieor.berkeley.edu), Fernando Alvarado (Wisconsin), George Gross (Illinois), and Tim Mount (Cornell)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Market Design, Market Operations	Key	Demonstration

11. PSERC-Design and Development of Bidding Agents for Electric Supply Auctions (M-5)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The goal of this work is to develop and demonstrate software agents for electric supply auctions, such that commercial performance is increased without compromising reliability. This work will develop bidding agents, an organization for these agents (particularly, the rules they must obey), and demonstrate these agents and their organization in simulated power systems.	What information and tools are needed to improve market performance? What is the optimum balance between system operations (ISOs), asset management (owners), and markets (buyers and sellers)?	• Identify ISO and Transmission Ownership requirements • Provide information and analysis to support bidding strategies • Develop systems to ensure transaction compliance • Develop rules and systems for congestion management	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period July 2001 to August 2004 •Funding – 2001: $73,000; 2002/2003: $108,000; 2004: $35,000	Sarosh Talukdar (Carnegie Mellon – lead; talukdar@ece.cmu.edu), Shmuel Oren (Berkeley), Robert J. Thomas (Cornell) and Tim Mount (Cornell)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Market Operations	Pacing	Demonstration / Development

12. PSERC-Modeling Market Signals for Transmission Adequacy Issues: Valuation of Transmission Facilities and Load Participation Contracts in Restructured Electric Power Systems (M-6)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
The use of an ISO of the transmission system may not provide enough incentives for appropriate investment and maintenance expenditures to achieve needed transmission reliability. Central to this problem are the proper definitions of market signals, and the valuation of transmission rights and facilities to allow credits for reliability and risk minimization of system operations. A proposed model to be developed in this project will simulate the competitive and volatile market environment together with the physical operating constraints of the system to provide a realistic tool for asset valuation, especially transmission assets.	Are current market designs inhibiting the development of new transmission facilities?	• Develop mechanisms to value and assign capacity rights • Develop modeling tools to test and simulate markets	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period June 1, 2002 to June 1, 2005 •Funding: $60,000 per year for three years.	Shi-Jie Deng (Georgia Tech-lead: deng@isye.gatech.edu). A.P. Meliopoulos (Georgia Tech), Tim Mount (Cornell); GE (Mark Sanford), Duke Energy (Noland Suddeth), Allegheny Power (Mahendra Patel), ABB (Xiaoming Feng)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Market Design	Key	Demonstration

13. PSERC-Structuring Electricity Markets for Demand Responsiveness: Experiments on Efficiency and Operational Consequences (M-7)

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Virtually all of today's electricity markets are single-sided, with limited demand-side patches like interruptible load or emergency demand response contracts available to a small set of customers. This project uses experimental methods with human agents on both sides of the market. Research topics include the nature and extent of demand responsiveness (e.g. load shifting, overall load reduction, and lags in customer response), how it interacts with supplier behavior, and the implications for market power (by both sellers and buyers), market efficiency, and system operating stability.	What information and tools are needed to improve market performance?	• Develop rules and systems for congestion management	•Project ongoing

Funding/Source	Participants	Point of Contact
•Funding Period June 1, 2002 to June 1, 2004 •Funding: $70,000 per year total for two years.	Richard E. Schuler (Cornell-lead: res1@cornell.edu); Duane Chapman, Timothy Mount, William Schulze, Robert Thomas, Ray Zimmerman (Cornell), Shmuel Oren (Berkeley); GE Power Systems (Mark Sanford); ISO-New England (Peter Wong); NYISO (Kathy Whitaker) and US DOE (Phil Overholt)	Dennis Ray Executive Director, PSERC (608) 265-3808 djray@engr.wisc.edu

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Market Operations	Key	Demonstration

14. CERTS-Market Mechanisms for Reliability Management

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
A core area of research examines market-based procurement of reliability or ancillary services, such as various operating reserves.	•Are current market designs inhibiting the development of new transmission facilities?	• Determine appropriate ancillary services • Develop modeling tools to test and simulate markets	CERTS is working to assist the industry in developing metrics for ancillary services, and conducting evaluations of proposed market designs and past market performance. A key research tool is experimental economics examinations of market designs couple with an electrically correct representation of the power system.

Funding/Source	Participants	Point of Contact
DOE Transmission Reliability Program; California Energy Commission	CERTS, PSERC	Fernando Alvarado University of Wisconsin/PSERC (608) 262-8900

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Market Design	Pacing	Development

15. Oak Ridge National Labs-Ancillary Services Project

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Demand response project to determine the cost and value of ancillary services such as spinning and supplemental reserves.	Are current market designs inhibiting the development of new transmission facilities?	• Determine appropriate ancillary services	Value the costs and benefits of ancillary services like spinning and supplemental reserves on the system.

Funding/Source	Participants	Point of Contact
DOE	DOE/Oak Ridge National Lab	John Stovall (865) 574-5198 Brendan Kirby (865) 576-1768

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Market Design	Pacing	Demonstration

16. California ISO-Short-Term Electricity Market Simulator

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Short-Term Electricity Market Simulator, Phase II: Design and develop a Forward Market Administration (FMA) and Market Participation (MP) simulation system.	Are the current market designs inhibiting the development of new transmission facilities?	•Develop modeling tools to test and simulate markets	The ability to test new market rules and designs on a robust model before it has to be implemented in code and tested on the real markets. Potential avoidance of major cost to fix flawed market systems.

Funding/Source	Participants	Point of Contact
CA ISO / EPRI / CEC	CA ISO / EPRI / CEC	David Hawkins California ISO (916) 351-4465 dhawkins@caiso.com

Project Area	Project Focus	Technology Characteristic	Project Type
Markets	Market Design	Pacing	Development

17. BC Hydro-Develop Transmission Pricing Methods Sensitive to Reliability

Project/Technology Development/Product	Issues	Research Initiatives	Expected Results
Develop transmission pricing methods which are sensitive to reliability and provide: •Price differentiation for different customers with different levels of reliability •Price signals to improve overall system reliability •Incentives to properly locate future generation and load	Are current market designs inhibiting the development of new transmission facilities? How can we improve the quality and quantity of operating information?	• Determine appropriate ancillary services • Develop modeling tools to test and simulate markets • Develop advanced decision support tools • Develop tools for obtaining and presenting system information for planning purposes	•Results of the project include a number of possible methods of implementing reliability-based pricing. •A final report has been issued. •Status: Completed March 2002

Funding/Source	Participants	Point of Contact
BC Hydro Strategic Research and Development Program	BC Hydro	Wenyuan Li and Stephen Tran (888) 964-9376

Project Area	Project Focus	Technology Characteristic	Project Type
Markets, Advanced System Operations	System Operability, Operating Information	Key	Demonstration